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THE INVERSION OF CANE SUGAR IN OFFICIAL SYRUPS.

By F. W. Haussmann.

The subject, which the writer would bring before the meeting, may be regarded as a preliminary paper to some work on syrups at present under way. At one of the meetings of the Pharmacopœial Research Committee of the P.C.P. last winter, a few observations pertaining thereto were related to the late Prof. Henry Trimble, and on his suggestion closer inquiry was made into a subject, regarded then as of little importance.

Syrup of hydriodic acid was the first preparation in which large quantities of a sugar reducing Fehling's solution were noticed.

Further investigation revealed, however, that the changes to be described were not confined to this syrup, but that others, containing strong mineral acids, showed the same conditions on prolonged standing.

The researches were consequently extended and other syrups, which developed marked color changes or heavy deposits without any apparent cause, were also examined. Such were syrup of calcium lactophosphate and syrup of the phosphates of iron, quinine and strychnine.

The syrups mentioned change in color, gradually turning anywhere from a straw color to brown, which in the case of syrup of hydriodic acid is usually attributed to the liberation of free iodine.

Such is, however, not the case.

In an examination of a number of specimens of this syrup, which

varied in color from light straw to deep brown, and in age from six months to two or even three years, not one was found to give a free iodine reaction.

Similar conditions prevail in the other two syrups mentioned.

The writer would offer the following explanation of this color change:

The free acid will invert the cane sugar in the syrup, with formation of glucose and laevulose.

The latter, according to Jungfleisch and Grimbart, decomposes much more readily than glucose, a pure solution turning yellow at 40° C.

Prolonged action of mineral acids also decomposes laevulose, with formation of formic and laevulinic acids, together with the indefinite coloring compounds, which the Germans describe under the title of "humin substancen."

That high temperatures have a certain influence on the production of these color changes, was illustrated during the hot days of the past summer.

Samples of syrups of hydriodic acid and calcium lactophosphate, which remained colorless through spring and early summer, in July and August almost simultaneously became straw colored to brown.

Syrups, thus inverted, will gradually deposit grape sugar. This takes place more readily in winter, as the higher summer temperatures will keep the glucose in solution.

The writer found this to be the case with syrups of hydriodic acid, calcium lactophosphate and syrup of the hypophosphites prepared according to Churchill's formula.

The deposit in a specimen of syrup of hydriodic acid, after being washed with small portions of water and alcohol to remove the acid, was dissolved in boiling alcohol, filtered while hot and allowed to redeposit.

The white warty mass thus obtained has a feebly sweet taste, is readily soluble in water and strongly reduces Fehling's solution.

It responds to all other reactions for grape sugar, and estimated with the alkaline cupric tartrate V. S. gave an anhydrous glucose percentage of over 75.

In the proceedings of the A. Ph. A. of 1893, some observations of Kulisch are recorded on the inversion of beet root sugar in the presence of natural fruit acids.

He also finds grape sugar to deposit from such syrups on standing and attributes it to the minor solubility of glucose in water.

Another result of cane sugar inversion in acid syrups is the diminished degree of sweetness.

In preparations containing no bitter principles this is readily noticeable and may be found in syrups of hydriodic acid and of Churchill's hypophosphites.

After examination of the official syrups containing free mineral acids, those with *organic* acids were likewise subjected to investigation and also gave indication of the inversion of the cane sugar although not in as pronounced a degree.

In both cases it was found that inversion is progressive and that at short intervals the respective examinations revealed a relatively greater amount of inverted sugar from the percentage previously found.

It was also observed that inversion progresses more rapidly in summer than winter.

The researches undertaken may be considered under the following heads:

(1) Syrups with free mineral acids.
(2) Syrups with free organic acids.
(3) Syrups without free acids.

SYRUPS WITH FREE MINERAL ACIDS.

These are syrups of hydriodic acid, calcium lactophosphate, phosphates of iron, quinine and strychnine, and hypophosphites.

SYRUP OF HYDRIODIC ACID.

This preparation may be found in time to possess all the peculiarities resulting from cane sugar inversion from the assumption of a straw color to a grape sugar deposit. The peculiar odor sometimes noticeable may, on the one hand, be due to the decomposition of the hypophosphorous acid present, but results in the majority of cases from the evolution of hydrogen sulphide from blued sugar.

The progressive inversion of cane sugar in this preparation was repeatedly studied, and the following examples, one carried out during winter, the other in summer, are hereby submitted.

Syrup of hydriodic acid was prepared in March of the present year by the official process from simple syrup prepared by cold per-

colation from carefully selected granulated sugar and distilled water.

The latter was examined with Fehling's solution as to the amount of inverted sugar and was found to contain between ·33 and 0·5 per cent.

Immediately after completion the syrup of hydriodic acid was examined and no increase in the inverted sugar percentage found.

After standing twenty-four hours a noticeable increase was shown, which, on estimation, proved to be 15·1 per cent.

Two weeks after preparation the percentage found was 62·5 calculated as glucose.

After standing for over six months with exposure to summer heat, the syrup became straw colored, contained no free iodine, and revealed almost the identical inverted sugar percentage of the previous examination.

During the warm days of August of this year a number of specimens of the syrup were prepared.

The following example is selected from these :

The syrup was prepared by agitation without heat, the sugar being dissolved in an aqueous solution of hydriodic acid, showing after one hour's standing, 1·5 per cent. of inverted sugar.

Forty hours afterward it was found to contain 43·8 per cent.

A subsequent examination, when the syrup was five days old, showed 62 per cent., and after one month approximately the same percentage was found.

A tally was kept on this preparation with a specimen of syrup also prepared by agitation containing 10 per cent. by weight of glycerin.

This was done to determine if the presence of glycerin retarded the inversion of the cane sugar.

Such was found not to be the case, the inversion also being progressive, eventually showing almost the same percentage of glucose as in the corresponding sample.

A number of specimens of the syrup prepared by the writer and obtained from other sources were also examined.

The following table furnishes the record of the *colored* syrups as to age and percentage of inverted sugar.

Color.	Age as Far as Known.	Per Cent. of Inverted Sugar Calculated as Glucose.	
1. Straw . . .	9 months.	58·4	
2. Brown	2½ years.	50·	
3. Straw	10 months.	59·5	No free iodine in any of these specimens.
4. Brown	2 years.	58·1	
5. Straw	6 months.	61·7	
6. Brown	20 months.	55·4	

SYRUP OF CALCIUM LACTOPHOSPHATE.

This preparation shows changes similar to syrup of hydriodic acid, gradually becoming straw colored, which may deepen to brown on prolonged standing, and not infrequently grape sugar deposits may be found.

The gradual inversion of the saccharose was observed in a syrup prepared in midwinter, the change being, due to the low temperature, somewhat slow.

The syrup was prepared according to official directions, four to five hours being required for completion.

Immediate examination gave evidence of but a slight amount of inverted sugar, which was not materially increased during twenty-four hours.

After three days, however, 2·8 per cent. was found, after one week, the syrup still being kept at a low temperature, the figure was 4·9 per cent., which was increased after sixteen days to 12·7 per cent. Gradual increases were found at various intervals during the following fifteen days, and after one month's standing 20·0 per cent. were found.

During the following six months the syrup retained its original colorless condition, until the heat of summer caused it to assume a straw color, which gradually deepened.

Examined after standing eight months, the syrup showed an inverted sugar percentage of 54·9.

Another specimen, prepared fourteen days afterwards, examined

at intervals, also showed progressive inversion, passes through the same color changes, and after eight months contains 56·8 per cent. of inverted sugar.

A brown, commercial sample of the syrup, about one year old, showed a percentage of 49.

SYRUP OF THE PHOSPHATES OF IRON, QUININE AND STRYCHNINE.

The difficulty of preserving Eaton's syrup is well known, various reasons having been advanced for the discoloration and precipitation taking place.

The chief criticisms have come from British sources and several recommendations for improvement, such as decrease in the amount of sugar and free acid, have been made.

In a subsequent paper, the writer will render his experience with this preparation.

At present he would state, that he believes the discoloration to be chiefly due to the inversion of the cane sugar with formation of brown side products, induced by the phosphoric acid.

The inversion of the cane sugar was also found to be progressive in the following instances:

The syrup was prepared according to official directions, employing simple syrup showing 0·33 per cent. of inverted sugar.

Seven hours after completion this was found to have increased to 1·95 per cent. and the increase was continued during three months, at the expiration of which the percentage found was 50.

This syrup was kept during the summer in filled, amber bottles, away from light, but subjected to heat, and an examination in early fall found it to be dark brown and containing approximately the same inverted sugar percentage.

Simultaneously with the foregoing Eaton's syrup was prepared by a modification of the official methods, in which sugar was directly employed and dissolved by agitation in the acid alkaloidal solution.

Four days after preparation the percentage found was 19·2, while when twenty days old the syrup contained 43 per cent. On four months' standing the syrup contained 56·8 per cent., and three months later, the now brown syrup showed a slight reduction from the last figure.

Other syrups examined were found to contain 54·9 and 56·4 per

cent. of inverted sugar after standing two months with exposure to summer heat.

A dark brown specimen, about ten months old, was found to contain 50·4 per cent.

SYRUP OF THE HYPOPHOSPHITES.

This preparation, as prepared by the pharmacopœial method, hardly deserves to be called syrup, containing only 50 per cent. cane sugar.

Singularly enough this official acid syrup differed from the others so far examined by showing no signs of color change.

A specimen of the syrup, contained in a partly filled bottle and exposed to every condition of temperature during eighteen months, still retains its original colorless appearance while giving evidence of decomposition otherwise.

This is probably due to the small percentage of free acid in the syrup.

With the well-known Churchill's syrup of the hypophosphites, which contains a larger quantity of free acid, the case is different, the writer having found this preparation to turn to a decided straw color, with a final deposit of grape sugar in cold weather.

Examination as to the amount of inverted sugar in the official syrup gave the oilowing results:

A sample six months old contained 20·8 per cent., while one of about eighteen months showed 29 per cent.

Progressive inversion was not studied in the official syrup.

It was, however, recently undertaken in Churchill's syrup, prepared by cold percolation.

The first portions of the syrup, dropping from the percolator, responded but feebly to Fehling's solution.

A contact of eighteen hours, however, revealed an inverted sugar percentage of 2·, while when forty-eight hours old the syrup was found to contain 3 per cent.

On standing four days, the percentage was found to be increased to 7·8 per cent., and in ten days to 18·1 per cent.

Recent examination, seventeen days after preparation, showed 27·7 per cent.

Other specimens of Churchill's syrup examined gave the following figures:

A slightly straw-colored syrup contained 56·4 per cent.; an old brown-yellow specimen, 62·3 per cent., and a straw-colored specimen, six months old, 58·2 per cent. of inverted sugar.

The salts of hypophosphorous acid have no reducing action upon Fehling's solution.

SYRUPS CONTAINING FREE ORGANIC ACIDS.

Organic acids also have the power of inverting saccharose, although not in as pronounced a degree as mineral acids.

The results, so far as decomposition or color changes, such as precipitation of grape sugar or darkening of syrups, are concerned, do not appear as prominently.

The experiments of Kulisch, mentioned before, indicate that heat and the *amount of free acid* are important factors in the course of inversion.

The latter view is substantiated by the results of the writer, but with the possible exception of the rapidity with which inversion takes place, a considerable increase in temperature is not necessary.

Prolonged contact of an organic acid with a cane-sugar solution will invert the saccharose at a temperature of 60° to 70° F.

This was found to be the case with syrup of citric acid.

The official syrups examined of the organic acid group were the following:

Syrup of citric acid, squill, ipecacuanha and acacia.

Syrup of garlic, being deeply colored, was not investigated.

SYRUP OF CITRIC ACID.

The phenomena of inversion of cane sugar in syrups with free organic acids were first observed in this preparation. Due to the absence of color, therefore permitting an accurate examination with Fehling's solution, it is particularly convenient.

The observations on the following specimen cover a period of eleven months:

Syrup of citric acid was made according to official directions, the simple syrup used in its preparation having but feeble reducing action.

After standing twenty-four hours, signs of the presence of inverted sugar made their appearance.

After standing forty-five days, it was found to be 22·7 per cent., and after three months, between 40 and 41 per cent.

The four-months old syrup showed the percentage to be increased to 49·2 per cent., and ten to eleven months after preparation the figure was 63·1 per cent.

This would indicate that almost all of the sugar was inverted.

Outside of a slightly terebinthinate odor, the syrup at this time shows no change.

SYRUP OF SQUILL.

A number of specimens of this syrup were examined, one being kept under observation for a period of seven months.

Heat is employed in the preparation of the syrup, and a more rapid inversion may therefore be expected.

The above-mentioned sample, one week after preparation, contained 6 per cent. of inverted sugar.

At various intervals examination showed constant increases, and after seven months 26·1 per cent. was found.

Other specimens showed, respectively, 12·5, 11 and 11·2 per cent., but none are as old as the above syrup.

SYRUP OF IPECACUANHA.

Syrup of ipecacuanha, containing but a small amount of free acid, shows the smallest inverted sugar percentage of all syrups examined.

Being prepared by cold solution, it does not show a favorable condition for inversion.

A specimen, under observation for three months, shows a percentage of 2·1, while the highest found in any sample was 3·7 per cent. Another syrup, of unknown age, showed 1·66 per cent.

SYRUP OF ACACIA.

This syrup gives evidence of the presence of inverted sugar on standing, or at least of a compound reducing Fehling's solution.

The question may be raised, if this reducing action is not an inherent property of acacia and its solution.

The Pharmacopœia states that the latter has no reducing action upon Fehling's solution.

This has not been the writer's experience with mucilage from either solid, granular or powdered commercial gums. Other glu-

cose tests, such as the alkaline bismuth and safranin tests, also react, the picric acid reaction being an exception.

Samples of syrups of acacia, prepared as follows, have these percentages:

No. 1, U.S.P. syrup, nearly four months old, examined in 1 per cent. solution by volume, showed 4 per cent. inverted sugar.

No. 2, a sample prepared from granulated gum, heat being employed in its preparation, contained 3·5 per cent. of inverted sugar in 100 c.c. of syrup after standing three months.

No. 3, a syrup prepared from powdered gum showed 4·5 per cent. in 100 c.c. after four months.

The sugar and syrup used in these preparations gave but a feeble reaction with Fehling's solution.

NON-ACID SYRUPS.

Examination of this group was undertaken to determine the question, if syrups, containing no free acids and standing the same length of time as acid syrups, may not eventually also show the presence of considerable amounts of inverted sugar. Various circumstances necessarily occurring during the preparation and keeping of such syrups, as the influence of direct or summer heat, or fermentation, render such a condition possible.

But while some do undoubtedly contain small amounts of inverted sugar, in no case was the percentage found as large as in the acid syrups of either group.

Even in comparison with the weakest of the latter, syrup of ipecacuanha, none was found to even approximately reach its percentage of inverted sugar.

The following groups were examined, several specimens of each in a number of instances.

Syrup of althæa. The syrup, prepared by a method in which the mucilage was removed, possessed, after five months, practically no reducing action upon Fehling's solution.

Examination of several specimens, prepared by other methods, gave similar results.

Syrup of senega, several months old, examined in diluted form, showed an almost complete absence of inverted sugar.

In examining this syrup in diluted form with Fehling's solution,

the blue color of the latter is turned green, but even on prolonged boiling only a slight precipitate of cuprous oxide is found.

Syrup of lactucarium was also examined in the above manner with the identical results.

Syrup of orange peel, U.S.P., showed, on standing six months, a percentage of only ·33 per cent. of inverted sugar, and a specimen prepared from spirit of orange showed, one month after preparation, but a feeble reducing power.

After six months, no material increase was noticeable.

Syrup of tolu was examined repeatedly, the percentage in all cases being low.

One sample showed ·4 per cent. on standing three months.

In simple syrup the highest inverted sugar percentage found was ·45 in a three-months old specimen, prepared by cold percolation.

The statement that continued boiling will invert the cane sugar in simple syrup, the writer has been unable to verify, unless free acid was present.

The following deductions may be briefly considered:

By the presence of directly fermentable sugars in acid syrups, a favorable condition for the liability of rapid fermentation must be taken into consideration by the pharmacist.

Such syrups, therefore require special attention concerning preservation.

The physician is confronted by an analogous difficulty, namely, the likelihood of rapid decomposition in the stomach with consequent gastric disturbance.

An objection to syrup of hydriodic acid, made by a physician, was the above complaint, and was attributed at the time to the liberation of iodine.

The above results, however, convince the writer that inverted sugar was the disturbing factor.

In plant chemistry a field for speculation is opened by the question: What influence have organic acids in the formation of the glucose regarded as a normal plant constituent?

Phosphorus Manufacture.—Phosphorus is now produced (*Scient. Amer.*, October 8, 1898) by means of the electrical furnace. The method consists in heating a mixture of phosphate of lime and coke, which are first reduced to a powder. When the mass becomes pasty, the openings of the furnace are sealed except one, through which the vapor passes. The vapor is collected and distilled.

PRODUCT PATENTS FROM A PHARMACEUTICAL STANDPOINT.

By William L. Cliffe, Ph.G.

"The Congress shall have power . . . to promote the progress of science and the useful arts by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries."—Constitution of the United States, Art. I, Sec. 8.

Acting under this constitutional mandate, the Congress of the United States enacted a statute in 1790, providing for the granting of patents upon things described as an "art, manufacture, engine, machine or device, or any improvement thereon."

From this as a nucleus was evolved a model of legislative brevity which is the fundamental law covering the granting of patents at the present time, and which was in force during the time most of the chemical product patents which it is the purpose of this paper to discuss were obtained. (Section 4,886, Revised Statutes, U. S.)

This statute, in force, provides for the granting of patents upon four classes of inventions, named therein as an *Art, Machine, Manufacture and composition of matter.* These are really increased to eight classes, as pointed out by Hon. Benjamin Butterworth, Commissioner of Patents (1884, 30 Official Gazette, 1,321), by the additional "for any new or useful improvement thereon."

From a chemical and pharmaceutical standpoint, under this law, there can be two classes of patents granted; one for an art, which is commonly described as a process patent; and another kind for a composition of matter, generally referred to as a product patent.

To the chemist seeking as a patentee a monopoly upon the results of his inventive skill, it is clearly a matter of self-interest to secure a product patent whenever he can do so by claiming invention of the product of a chemical process.

The reason for this is obvious: granting a patent upon the end product of a chemical process effectively bars all possibility of competition with other inventors working in the same field.

It seems clear to the mind of a layman that this restriction of improvement is clearly in opposition to a fundamental provision of patent legislation as expressed in the statute, to wit, "for any new and useful improvement thereon."

Decisions by courts of last resort are not wanting in which this opinion seems to be sustained. Frequently have the claims of patents been rejected and stricken out on account of being broad enough to kill all competitive exercise of the inventive faculty during the life of the patent.

A notable instance being the Morse Telegraph Patent; the eighth claim of this patent was construed by the Supreme Court to be for the use of the electric current for making intelligible signs at any distance. The Supreme Court held this claim to be void. (O'Reilly *v.* Morse, 15 Howard, 112, 1853.)

This patent, if granted, would have covered the use of a principle and shut out from all competitors the use of the electric current for telegraphic purposes; "any new and useful improvement" over Morse's invention could not have been utilized. In clear distinction to this in the line of chemical patents, stands the process patent or a patent for an art (in a patent law sense); in granting which, of course, the proof of exercise of the inventive faculty is and should be demanded. Pettit (law of inventions, 1895) defines process in its patent law sense in the following terms: "A process may be said to be a directing or training of a force in a given manner through the medium of physical agents applied to material objects, whereby are produced material effects."

Probably one of the best illustrations of a chemical process patent was that granted to Richard Tilghman, of Philadelphia, for the manufacture of glycerine by the action of super-heated steam upon fats.

The claim of this patent was for "the manufacture of fat acids and glycerine from fatty bodies by the *action of water at a high temperature* and *pressure*."

Had Tilghman been able to claim the invention of the product, glycerine (discovered by Chevreul in 1813), he would never have been called upon to defend his patent by suing Proctor for infringement, because no matter what improvements Proctor did or hoped to make, would be shut out by the stone wall of an end product patent, during its term. To illustrate the advantages enjoyed by the chemical patentee who is lucky enough to secure a product patent over his confrère who invents a machine, the following is a good illustration. A patent was granted upon a machine for sawing shingles; another was granted for an improvement consisting of the

identical machine with a circular saw substituted for a perpendicular reciprocating saw. This patent for improvement was granted to the original inventor, but the logic of the law would require the grant to any other inventor. (Earl *vs.* Sawyer, 4th Mason 1, 1825.)

With this summing up of the legal aspects of product patents, it would be well to proceed to the consideration of the

COMMERCIAL ASPECTS.

Clear up to the early '80's, very little advantage was taken of the liberal provisions of our patent laws, but about this time, enterprising chemists in Germany (our laws permit foreigners to take out patents) saw the possibilities of the situation in the United States. After a few tentative patents, the ventures proved profitable beyond the clear calculations of commercial prescience. At the present time, there are no reports from the patent office which do not include numerous examples of this class of patents granted to German inventors. These patents are generally assigned to trustees in this country for the purpose of protection against infringement and of managing the business of selling. In almost every instance, the product is made abroad, bringing to this country nothing but the ad valorem tariff duty on their *actual value* as commercial commodities. The prices at which they are sold here are clearly indicative of a greed and rapacity which seem to be unrivalled in any other form of commercial monopoly. Taking, for instance, the case of phenacetin; it is probable that the outside approximate cost of this article, landed in this country, duty paid and put up in 1-ounce packages, is 10 cents per ounce; the selling price to the trade is $1 per ounce. To get an accurate idea of what had been wrested from the people of these United States upon this one article, the writer appealed to the Bureau of Statistics of the Treasury Department, but received the information that prior to 1895 there are no records of any importation of phenacetin, as such, and since that time only a few thousand ounces have been imported; these being various lots that were imported by others than the accredited agents of the trustee in claimed infringement upon the rights of the patent. The chemical and pharmaceutical trade in this country hold to the opinion that an estimate of 300,000 ounces a year for the term of the patent is conservative. Deducting the cost and jobber's commission would leave about 75

cents per ounce, amounting in this case to $2,025,000. Think of this from one product alone! In the case of others, which did not present the possibilities of such extended use as phenacetin, the ratio of percentage profit was increased, sometimes trebled or quadrupled.

Antipyrin was never as popular as phenacetin, but it is probable that nearly as much profit was obtained from the monopoly during its life, as it sold for $1.35 per ounce.

This then, is a condition of affairs here, but how different in Germany! There, the financial increment has built up numerous finely equipped laboratories, with scores of trained chemists and investigators, whose sole duty to the companies in control is to *find some new and useful composition of matter to patent in the United States.* Germany, undoubtedly scented the possibilities of the chemical product patent monopoly first, and having the finest laboratories of instruction at that time, has greatly increased her advantages and organized facilities through the aid of dollars stamped U. S.

It might be asked "What were our own chemists doing in not taking advantage of a condition of affairs which was presumably created for their benefit?" The question is capable of an answer which proves them the victims of ulterior conditions, but for the purpose of this discussion, it would be too lengthy to consider at this time.

There is still another side to this question, namely, its ethical one, which has always been a prominent factor in any question in which medicine and pharmacy has been involved. This factor has been ably handled in editorials in the *Bulletin of Pharmacy*, *Alumni Repoit*, *P.C.P.*, *Paint Oil and Drug Reporter*, and other drug journals.

Note.—The legal authorities used and quoted are Robinson on Patents, Vol. I; Walker on Patents, third edition, 1895; Pettit, Law of invention, 1895.

Heat and Diarrhœa.—Cohn (*Arch. f. Kinderheilk.*) has studied the milk, the bottles, and the artificial food of a number of infants during several years, and finds that even where the food is in good condition and unchanged, as in breast-fed babies, the heat of summer may disturb the digestion of infants in some unknown way, and this must be considered as a factor in the etiology of diarrhœa in artificially fed children during the summer months.—*Pediatrics*, 1898, 919; from *Am. Jour. Obstet.*

MEDICINAL LITHIUM CARBONATE.

By Lyman F. Kebler.

Research Committee E, Pharmacopœia Revision.

Before considering the properties of lithium carbonate it might be well to briefly review its sources and methods of manufacture. Lithium, although widely diffused in small quantities, is found available for economical extraction in only a few localities. The minerals containing it most abundantly are the bisilicates of *petalite* and *spodumene*, the unisilicate *lepidolite* and the phosphates of *triphilite*, *amblygonite* and *lithiophilite*.

Lepidolite is (or probably better, has been) the source of much lithium carbonate, which is extracted by E. Schering's[1] process as follows: The finely-ground lepidolite is mixed with warm sulphuric acid to the consistence of a thin paste, which is then heated and stirred until agglomeration results. The resulting lumps are then calcined in a reverberatory furnace, cooled, and while yet warm are lixiviated with water. From this solution most of the aluminum is removed as potassium alum and the bases are farther removed by means of milk of lime. The remaining bases are converted into chlorides by precipitation with a solution of barium chloride, and the clear solution evaporated to dryness. The dry residue is next digested with absolute alcohol, which removes lithium and calcium chlorides. The alcohol is distilled off, the residue taken up with water and the calcium removed as an oxalate. The small amount of foreign metals still present is removed by treating the filtrate with ammonia and ammonium sulphide. The filtrate is now evaporated to dryness, the pure lithium chloride taken up with a suitable quantity of water and converted into the carbonate by adding the proper quantity of a concentrated solution of ammonium carbonate. The lithium carbonate is finally collected, washed with 60 per cent. alcohol and dried.

A. Schrötter's[2] method, for similar minerals, is probably the best commercially, but does not give as pure an article. By this method the minerals are fused at a red heat and while molten are ladled out into water. When cold, the mass is powdered, mixed with a suitable quantity of water and treated with hydrochloric acid (sp. gr. 1·2). After standing twenty-four hours the whole is heated to nearly boiling, and in a few hours most of the silica will be separated. The iron is then oxidized with a little nitric acid and most of

the bases, except alkalies, precipitated by carefully adding a solution of sodium carbonate to the boiling, moderately dilute liquid. The precipitate is removed by filtration or otherwise, and the filtrate concentrated to remove a small amount of foreign carbonates still present. The lithium chloride solution is finally concentrated, the lithium carbonate precipitated by means of a solution of sodium carbonate, collected, washed and dried.

M. H. Müller[3] devised a method for working the phosphates, some years ago, and the same process is, probably, in use at present. The powdered mineral is treated with hydrochloric acid, the iron oxidized by means of nitric acid, the phosphoric acid precipitated with a ferric salt, the mixture evaporated to dryness and the residue extracted with water. The resulting solution contains the alkaline chlorides, manganous chloride and some iron chloride. The manganese, etc., are removed with barium sulphide. The excess of barium is removed with sulphuric acid and filtration. The lithium carbonate is precipitated from the filtrate by means of sodium carbonate or carbon dioxide gas. For other useful literature on the manufacture of lithium carbonate see reference at end of this article.[4]

From the above information we can readily judge what impurities are likely to be met with in lithium carbonate, viz.: traces of the powdered mineral itself, any of the bases associated with the lithium and impurities introduced through the solvents or precipitants.

The 1890 U.S.P. describes lithium carbonate as a light, white powder, odorless, of an alkaline taste and reaction, and permanent in the air. It is soluble in 80 parts of water at 15° C. and 140 parts of boiling water, much more soluble in water impregnated with carbon dioxide gas, soluble in acids with active effervescence, insoluble in alcohol, fuses at a low red heat, and at a higher temperature is partially converted into the oxide, with evolution of carbon dioxide gas. One gramme treated with 40 c.c. of dilute acetic acid should produce a clear solution, separate portions of which should not be affected with solutions of *silver nitrate, hydrogen sulphide, barium chloride, ammonium oxalate, ammonium sulphide* or *sodium cobaltic nitrite.* The dried chloride from one half gramme of lithium carbonate should be completely soluble in 3 c.c. of absolute alcohol, and the addition of 3 c.c. of ether should not produce a turbidity. The salt should contain 98·98 per cent. of pure lithium

carbonate when titrated with normal sulphuric acid and methyl orange as indicator.

The *Arzneibuch für das Deutsche Reich*, 3d ed., 1895, contains almost the same requirements, but omits the rigid ammonium sulphide test.

The English Pharmacopœia of 1898 is somewhat less exacting.

An examination of the lithium carbonate available in the United States shows that not a single sample complies with the U.S.P. requirements. The results of the eight samples examined are contained in the table opposite:

Let us now examine the U.S.P. requirements seriatim. Lithium carbonate is a light, white powder, odorless, of an alkaline reaction and taste.

Sample number *one* differed materially from all the others in physical appearance; being bulkier, notably free from agglutination, and smooth and soft like starch. This difference is probably due to the method of manufacture. If lithium carbonate is prepared from lithium sulphate, by the use of potassium carbonate, a harsh, sandy powder is the result; but on dissolving the lithium carbonate thus formed, in hydrochloric acid, and then precipitating with ammonium carbonate, a beautiful voluminous product is the result. No. 1.

It will be noticed, under microscopical examination, that crystals are frequently present. This point ought to be noted in the description. These crystals are produced in several ways. On boiling a solution saturated with carbon dioxide gas; by spontaneous evaporation of a similar or other solutions; the lithium carbonate separates as prismatic crystals, or as crystalline crusts.

Lithium carbonate is soluble in 80 parts of water at 15° C., and in 140 parts of boiling water. Much more soluble in water impregnated with carbon dioxide. Soluble in acids, with active effervescence. Insoluble in alcohol.

The data on the solubility of this chemical are greatly at variance. P. Kremers[5] states that 100 parts of water at 13° C. dissolve 0·769 parts, while the same quantity at 102° C. dissolves 0·778 parts of the salt. L. Troast[6] says 100 parts of hot or cold water dissolve 1·2 parts of lithium carbonate. E. Schmidt,[7] 75 parts of water at 20° C. dissolve 1 part of the salt. C. N. Draper,[8] 100 parts of water will dissolve 1·4787 at 15° C., and 0·7162 at 100° C.

No.	Physical Appearance.	Microscopical Examination.	Per Cent. of Lithium Carbonate, Volumetrically.	Per Cent. of Lithium Carbonate, Gravimetrically.	Impurities.	Solubility at 15° C.	Remarks.
1 . . .	Excellent, smooth and uniform.	Some crystals, mostly amorphous.	96·20	98·63	Sulphates, chlorides, iron and calcium.	1–80 Slight residue.	Sulphates, excessive. Acetic acid solution, opalescent. Coloration with H_2S and $(NH_4)_2S$ solutions.
2 . . .	Fair, lumpy.	Amorphous.	98·42	97·70	Sulphates and chlorides	1–80 Slight residue.	Acetic acid solution, opalescent. Coloration with H_2S and $(NH_4)_2S$ solutions.
3 . . .	Fair, lumpy.	Amorphous.	98·79	100·00	Calcium and chlorides.	1–79 Slight residue.	Acetic acid solution, opalescent. Coloration with H_2S and $(NH_4)_2S$ solutions.
4 . .	Fair, lumpy.	Amorphous.	99·50	97·77	Chlorides.	1–76 Residue, trace.	Acetic acid solution, opalescent. Coloration with $(NH_4)_2S$ solution.
5 . . .	Excellent, lumpy.	Some crystals, mostly amorphous.	99·16	97·77	Sulphates and chlorides.	1–78 Slight residue.	Acetic acid solution, opalescent. Coloration with $(NH_4)_2S$ solution. Chlorides, excessive.
6 . . .	Fair, lumpy.	Amorphous.	99·13	—	Aluminum, sulphates, iron and calcium.	1–80 Slight residue.	Acetic acid solution, opalescent. Coloration with H_2S and $(NH_4)_2S$ solutions.
7 . . .	Fair, lumpy.	Amorphous.	98·63	—	Sulphates.	1–80 Slight residue.	Acetic acid solution, opalescent. Coloration with $(NH_4)_2S$ solution.
8 . . .	Fair, lumpy.	Some crystals, mostly amorphous.	97·50	—	Sulphates.	1–80 Slight residue	Acetic acid solution, opalescent. Coloration with $(NH_4)_2S$ solution.

J. Bewad,[9] 100 of water at 20° C. dissolve 1·329, and the same amount of water dissolves 0·796 parts or 0·955, according as the solution is boiled one-fourth or one-half hour. F. A. Flückiger,[1] and H. Selzer[11] confirm Bewad's results. By long spontaneous evaporation a solution can be obtained which contains 2 per cent. of lithium carbonate.

The results recorded in the above table on solubility were obtained by the digestion method. In every case there was present a small amount of insoluble residue even with 100 parts of water. The impurity also manifested itself on dissolving the chemical in dilute acetic acid or other acids. This is, without doubt, an accidental or incidental mechanical impurity, and should be taken into consideration when prescribing limitations.

One gramme of lithium carbonate required from 136 to 140 parts of boiling water for complete solution. The samples in each case were finely powdered, so that all lumpiness was eliminated.

The statement that the salt is soluble in dilute acids is somewhat sweeping. It might be well to state that lithium phosphate is somewhat insoluble and considerable excess of the phosphoric acid may be needed.

On cooling fused lithium carbonate, a crystalline mass results, which disintegrates into pearly particles. When the salt is heated to a high temperature, in the presence of air, the greater part of the carbonate is converted into the super oxide and the platinum crucible (if used) is attacked.

A glance at the columns headed Impurities and Remarks, of the preceding table, will render comments in this connection unnecessary.

The operation given in the Pharmacopœia for detecting excessive amounts of other alkalies, based on the solubility of a given amount of lithium chloride in absolute alcohol and ether, is rather impracticable. Absolute alcohol is very hygroscopic and lithium chloride is extremely deliquescent, making a combination that requires skill and apparatus to manage, so as to secure reliable results. The writer is of the opinion that this requirement could easily be dispensed with, without materially affecting the standard for this chemical. The solubilities, the flame test and the sodium cobaltic nitrite practically eliminate other alkalies. The test might be retained for information.

One gramme of pure lithium carbonate requires 27·0745 c.c. of normal acid for complete neutralization. The U.S.P. requires not less than 26·8 c.c. per gramme, corresponding to 98·98 per cent. of pure salt. According to the results in the preceding table the average of *thirteen* determinations of *eight* samples, *eight* volumetric and *five* gravimetric, is 98·4 per cent. Volumetric alone, 98·41 per cent. Eliminating the lowest volumetric result, we obtain 98·71 per cent. as the average of seven determinations of as many samples.

In the Digest of Criticisms on the U.S.P. of 1890 (1897), Part I, p. 103, we find the following: "One gramme carbonate of lithium requires for neutralization 27·745 c.c. normal sulphuric acid; Ph. Germ. III directs at least 26·8 c.c. acid for one gramme of the salt, corresponding to 96·59 per cent. of the pure carbonate, which is exactly the strength Curtman has found in all the specimens examined by him."

These figures are correctly quoted from Circ. No. 112, p. 676. There are, however, several errors in the circular. The number of cubic centimeters, 27·745, should read 27·0745, the cipher having been inadvertently omitted. 26·8 c.c. of normal sulphuric acid *do not* correspond to 96·59 per cent. of pure carbonate, but to 98·98 per cent., which is probably what was meant and is correct in the U.S.P.

98·98 per cent. is a trifle higher than the best average result obtained by the writer, viz.: 98·71 per cent. The writer is of the opinion that the mechanical impurities contribute largely towards lowering the per cent.

The volumetric and the gravimetric methods were carefully compared. The conclusion is decidedly in favor of the volumetric process.

According to the above data, Lithium Carbonate is a light, white powder, with occasional crystalline grains, odorless and having an alkaline taste; permanent in the air.

Soluble in not less than 75 parts, and should not require more than 80 parts of water at 15° C., and in 140 parts of boiling water; much more soluble in water impregnated with carbon dioxide; insoluble in alcohol. Soluble in dilute nitric, sulphuric, hydrochloric and acetic acids, with active effervescence.

Fuses at a low red heat; loses carbon dioxide at a higher temperature, and is partially converted into the oxide. It imparts a crimson color to a non-luminous flame.

The aqueous solution has an alkaline reaction upon litmus paper.

One gramme dissolved in 50 c.c. of dilute acetic acid should at most leave only a trace of insoluble matter (limit of *mechanical impurities*). Separate portions of this solution should not be affected by: hydrogen sulphide, T. S. (absence of *arsenic*, *lead*, etc.); ammonium oxalate, T. S. (absence of *calcium*), or sodium cobaltic nitrite, T. S. (limit of *potassium*); or produce more than a faint opalescence with silver nitrate T. S. (limit of *chloride*); barium chloride T. S. (limit of *sulphate*); or more than a slight coloration with ammonium sulphide T. S. (limit of *iron*, *manganese*, etc.).

If 0·5 gramme of Lithium Carbonate be dissolved in 2 c.c. of hydrochloric acid and the clear solution evaporated to dryness, the *dry* residue should dissolve completely in 3 c.c. of absolute alcohol, and 3 c.c. of ether added to this solution should not render it turbid (limit of *other alkalies*).

If 1 gramme of the dry salt be mixed with 25 c.c. of water, to which have been added a few drops of methyl-orange solution, it should require not less than 26·7 c.c. of normal sulphuric acid, corresponding to at least 98·61 per cent. of the pure salt.

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Rhus Poisoning may be treated successfully by an application of ammonium muriate: 1 ounce to be dissolved in two quarts of warm water. The solution is to be applied on cloth or absorbent cotton, covered with oil silk or rubber tissue. —A. T. Hudson, in *N. Y. Med. Rec.*

QUALITATIVE EXAMINATION OF POWDERED VEGETABLE DRUGS.

By Henry Kraemer.

(*Concluded from No. 11, p. 573.*)

C. NO STARCH OR CRYSTALS OF CALCIUM OXALATE, BUT MASSES OR CRYSTALS OF A CARBOHYDRATE (INULIN).

The *Inulin* occurs in numerous irregular nearly transparent or grayish fragments, sometimes perfect sphere-crystals. These masses or crystals are soluble in hot water; insoluble in alcohol and glycerin.

368. *Inula.*—Grayish-brown masses from secretion reservoirs; few sklerenchyma fibres (15 μ wide); reticulated ducts 32 μ wide; odor and taste.

369. *Lappa.*—Apparent absence of secretion reservoirs; more wood fibres and possibly larger reticulated ducts (as much as 70 μ wide) than Inula; cells of periderm brownish, becoming yellow with age; parenchyma very light colored; no odor.

370. *Pyrethrum* —Characterized by a stone cork (30 x 45 μ) with yellowish-brown contents; few sklerenchyma fibres; narrow reticulated ducts about 15 μ wide; characteristic parenchyma; oil secretion reservoirs; taste.

371. *Taraxacum.*—Characteristic milk vessels in chloral-iodine mount. See No. 165.

IV. POSSESSING SECRETION HAIRS, CELLS OR RESERVOIRS AND OF SOMEWHAT CHARACTERISTIC ODOR.

A. SECRETION HAIRS.

372. *Anthemis.*—Non-secreting and secreting hairs; spherical prickly pollen grains (32 μ) which may not be numerous; papillæ of corolla and stigma; sklerenchyma fibres (10 μ wide) the walls of which are very much thickened; small rosette-shaped calcium oxalate crystals sometimes found; characteristic cells of anther.

373. *Arnicæ Flores.*—Numerous spherical prickly pollen grains (30 μ); secretion hairs; sklerenchyma fibres; characteristic non-secreting hairs of pappus (like top of pineapple fruit); outer portion of corolla and ovary.

374. *Belladonnæ Folia.*—See No. 46.

375. *Cusso.*—See No. 345.

376. *Lupulin.*—Large characteristic secretion hairs (20 x 20 μ). In *fresh* Lupulin more light yellow colored secretion hairs than in *old*. In latter there are, browner or grayish-brown resinous masses replacing the light yellow oil. The amount of *Humulus* fragments should not be too large in good quality. See No. 537.

377. *Santonica.*—See No. 350.

B. SECRETION CELLS OR RESERVOIRS.

378. *Aurantii Amari Cortex.*—See No. 206, crystals of calcium oxalate.

379. *Aurantii Dulcis Cortex.*—See No. 207, crystals of calcium oxalate.

380. *Inula.*—See No. 368, Inulin masses or crystals.

381. *Limonis Cortex.*—See No. 208, crystals of calcium oxalate.

382. *Macis.*—A peculiar starch (becomes red with iodine and called "dextrin starch") in small irregular particles; yellowish (oil) and reddish (resin) secretion cells (75 μ); few ducts; H_2SO_4 stains contents of secretion cells bright red; KOH stains contents of secretion cells a yellow. *Bombay mace* gives with H_2SO_4 a yellowish reaction; the oil secretion cells and "dextrin starch" grains are possibly larger; the epidermal cells are radially elongated and the collenchymatic layer underneath may be wanting in Bombay mace.

383. *Pyrethrum.*—Stone cork. See No. 370.

V. PRESENCE OF SKLERENCHYMA CELLS (STONE CELLS) OR FIBRES (BAST OR WOOD).

A. STONE CELLS.

384. *Aconiti Radix.*—Starch. See No. 319.

385. *Asclepias.*—Crystals and starch. See No. 242.

385a. *Black Mustard Hulls.*—Chiefly fragments of seed coat.

386. *Cocoa Shells.*—Little or no starch; oil globules; characteristic brownish adhesive fragments, possessing more or less hexagonal epidermal cells; peculiar small tabular mucilage cells and a layer of nearly isodiametric stone cells (10 x 10 μ) the walls of which are 4 μ thick.

387. *Canella alba.*—Crystals, starch, secretion reservoirs. See No. 244.

388. *Capsicum.*—Small starch grains might not be observed;

reddish-colored oily drops; peculiar wavy cells of seed coat besides stone cells of epicarp and endocarp; secretion hairs of calyx; powder with H_2SO_4 becomes purplish, changing to purplish-red.

389. *Cardamom.*—Starch and crystals. See No. 270.

390. *Clove Stem.*—The presence of stone cells distinguish it from cloves. See No. 347.

391. *Coffee.*—Oil, aleuron, starch and epidermis with spindle-shaped stone cells. See No. 324.

392. *Colchici Semen.*—Starch, oil and protein. See No. 326.

393. *Colocynthis.*—Stone cells (70 x 50 μ) of fruit, the walls of which are 15 μ thick; also find characteristic yellowish, nearly isodiametric stone cells of seed containing very thick walls and but little lumen; embryo contains oil and aleuron. The *amount of seed* in powder can be determined from the amount of oil in the form of globules. The U.S.P. directs only pulp, and not seeds or epicarp.

394. *Composition Powder.*—Tissues of ginger, cloves, capsicum and bayberry. See No. 245.

395. *Cubeba.*—Starch and secretion reservoirs. See No. 308.

396. *Delphinium.*—No starch; oil and protein; characteristic stone cells (32 x 175 μ) forming the inner epidermis and containing a reddish-brown coloring substance; also spatulate cells (outer epidermis of seed coat) with simple pores.

397. *Galla.*—Crystals and starch. See No 247.

398. *Guarana.*—Starch. See No. 328.

399. *Hicra Picra.*—Canella and aloes. See. No. 255.

400. *Illicium.*—Palisade sklerenchyma. See No. 356.

401. *Jalapa.*—Crystals and starch. See No. 250.

402. *Juglans.*—Crystals and oil. See No. 251.

403. *Pareira.*—Starch. See No. 329.

404. *Prunus Virginiana.*—Starch and crystals. See No. 282.

405. *Pulv. Jalapæ Comp.*—Jalapa and potassii bitartras. See No. 256.

406. *Quercus alba.*—Crystals and tannin. See No. 360.

407. *Pimenta.*—Crystals, starch and oil. See No. 254.

408. *Pyrethrum.*—Inulin and stone cork. See No. 370.

409. *Rumex crispus.*—Crystals and starch. See No. 260.

410. *Syr. Trifolii Comp.* (*Powder*).—Stillingia, Xanthoxylum fraxineum, Lappa, Phytolacca, Berberis aquifolium, Cascara amarga and red clover. See No. 263.

411. *Vanilla.*—No starch. See No. 363.

412. *Viburnum prunifolium.*—Crystals, more stone cells and fewer sklerenchyma fibres. See No. 265.

B. SKLERENCHYMA FIBRES.

413. *Althæa.*—Crystals, starch and mucilage. See No. 238.

414 *Anthemis.*—Pollen. See No. 372.

415. *Apocynum.*—Starch. See No. 320.

416. *Arnicæ Flores.*—Pollen. See No. 373.

417. *Aspidosperma.*—Crystals in crystal fibres. See No. 267.

418. *Belladonnæ Radix.*—Starch. See No. 298.

419. *Cardamom.*—Crystals and starch. See No. 270.

420. *Cascarilla.*—Crystals and starch. See No. 243.

421. *Cinchona.*—Characteristic bast fibres. See No. 299.

422. *Cinnamon.*—Starch, crystals and stone cells. See No. 292.

423. *Cloves.*—Few sklerenchyma fibres and numerous large secretion reservoirs. See No. 346.

424. *Clove Stems.*—Stone cells, numerous sklerenchyma fibres. See No. 347.

425. *Cubeba.*—Starch, oil, stone cells. See No. 308.

426. *Euonymus.*—Crystals and starch. See No. 246.

427. *Ext. Glycyrrhizæ.*—See No. 272.

428. *Ext. Sarsaparillæ Fld.* (Powder).—Tissues of sarsaparilla, glycyrrhiza, sassafras and mezereum. See No. 273.

429. *Frangula.*—Crystals, starch, but *no* stone cells. See No. 274.

430. *Gelsemium.*—Crystals and starch. See No. 275.

431. *Ginger, Charcoal and Magnesia.*—Tissues of ginger, willow charcoal and particles of MgO. See No. 277.

432. *Glycyrrhiza.*—Crystals and starch. See No. 276.

434. *Gossypii Rad. Cort.*—Crystals, starch and secretion reservoirs. See No. 249.

435. *Hydrangea.*—Crystals and starch. See No. 293.

436. *Illicum.*—Palisade sklerenchyma. See No. 356.

437. *Inula.*—See No. 368.

438. *Ipecac.*—Crystals and starch. See No. 294.

439. *Juglans.*—Crystals, oil and tannin. See No. 251.

440. *Krameria.*—Crystals, starch and coloring substance. See No. 279.

441. *Lappa.*—Inulin. See No. 369.

442. *Myrica Cerifera.*—Crystals in crystal fibres. See No. 252.

443. *Pareira.*—Starch and numerous stone cells. See No. 329.

444. *Phytolaccæ Radix.*—Crystals and starch. See No. 301.

445. *Podophyllum.*—Crystals and starch. See No. 332.

446. *Prunus Virginiana.*—Crystals and starch. See No. 282.

447. *Pulv. Aromaticus.*—Tissues of cinnamon, ginger, cardamom and nutmeg. See No. 295.

448. *Pulv. Glycyrrhizæ Comp.*—Tissues of glycyrrhiza and senna. See No. 283.

449. *Pulv. Ipecac. et Opii.*—Tissues of ipecac and opium; also crystals of sugar of milk. See No 296.

450. *Pyrethrum.*—Inulin, stone cork. See No. 370.

451. *Quassia.*—Crystals. See No. 359.

452. *Quercus alba.*—Crystals and stone cells. See No. 360.

453. *Quillaja.*—Crystals and starch. See No. 284.

454. *Rubus.*—Crystals and starch. See No. 259.

455. *Rumex Crispus.*—Crystals, starch and stone cells. See No 260.

456. *Sabina.*—Starch and "hypodermis fibres." See No. 311.

457. *Sassafras.*—Starch, oil and tannin. See No. 313.

458. *Serpentaria.*—Starch. See No. 145.

459. *Stillingia.*—Crystals, starch and oil. See No. 262.

460. *Sumbul.*—Starch and oil. See No. 125.

461. *Syr. White Pine Comp.*—Tissues of wild cherry, Aralia spinosa, sassafras, sanguinaria, white pine bark and balm of gilead buds. See No. 285.

462. *Tr. Cinchonæ Comp.* (*Powder*).—Tissues of cinchona, bitter orange peel and serpentaria. See No. 303.

463. *Ulmus.*—Crystals, starch and mucilage. See No. 285.

464. *Viburnum opulus.*—Crystal fibres and sklerenchyma fibres. See Nos. 287 and 265.

465. *Willow Charcoal.*—In glycerin mounts, wine-colored or dark reddish or blackish irregular-shaped fragments containing wood fibres; transverse fragments with lumen.

466. *Xanthoxylum.*—Crystals, starch and oil. See No. 289.

VI. ABSENCE OF SKLERENCHYMA.

467. *Gentian.*—Yellowish oil globules; spiral (30 μ wide), and scalariform (50 μ wide) ducts; small colorless and yellow prismatic

crystals (which may be calcium oxalate crystals); large (5 x 15 μ) prismatic crystals separate in glycerin mounts which may be a sugar; characteristic "Ersatzfasern" accompanying the sieve.

VII. CHARACTERISTIC POLLEN GRAINS.

468. *Anthemis.*—See No. 372.

469. *Arnicæ Flores.*—See No. 373.

470. *Carthamus.*—Glycerin, of mount, colored yellow; numerous elliptical, prickly pollen grains, which are more or less elliptical (50 x 60 μ); brick-red secretion vessels; cells of anther; hairs of stigma; chaff or pappus.

471. *Caryophyllus.*—See No. 346.

472. *Crocus.*—Glycerin of mount colored deep orange; few nearly smooth, nearly spherical pollen grains (85–100 μ); papillæ of stigma; coloring principle soluble in water and not in fatty oils, being the reverse in *Capsicum;* with H_2SO_4 fragments become blue immediately.

473. *Rosa centifolia.*—Pollen grains nearly smooth and elliptical (17 x 30 μ); fragments of corolla pinkish with chloral; papillæ of corolla are somewhat rounded; cells of anther; long, 1-celled fibres around ovary and akenes being 875 μ long and 10 μ wide. In *Rosa gallica* the pollen grains are ovate (28 x 32 μ) rather than elliptical; the papillæ of corolla are acute rather than rounded; absence of many anthers or fibres of ovary.

474. *Sambucus.*—No starch; numerous smooth, nearly spherical pollen grains (18 x 18 μ); numerous fragments of broken or whole anthers; corolla with dentate papillæ; oil globules from secretion cells; in calyx some rosette-shaped crystals of calcium oxalate; in flower stalk large spiral ducts (30 μ wide), and parenchyma with brown contents.

475. *Santonica.* See No. 350.

VIII. LITTLE OR NO INDICATION OF PLANT TISSUES.

A. CONTAINING STARCH.

476. *Amylum Iodatum.*—See No. 335.

477. *Bryonia.*—See No. 336.

478. *Colchici Cormis.*—See No. 337.

479. *Ext. Glycyrrhizæ.*—Irregular, wine-colored fragments; al-

tered and unaltered starch grains; few fragments of bast and crystal fibres of glycyrrhiza; soluble in water and taste sweetish.

480. *Opium.*—Insoluble in water; taste bitter. See No. 338.

B. WITHOUT STARCH.

a. Particles of organized form.

481. *Corn Smut.*—Grayish-brown, nearly spherical spores (7 x 7 μ); little or no foreign substances. Spores of *Coprinus comatus*, blackish and elliptical (10 x 5 μ). Spores of *Agaricus campestris* more brownish than corn smut, are egg-shaped and in size about 5 x 7 μ.

b. Particles of inorganic form.

a. *Remain opaque (not affected) in glycerin.*

482. *Aloes (Socotrine).*—Partially unaffected. See No. 487.

483. *Benzoin.*—Colorless and wine-colored irregular fragments; some rosette-shaped groups and collection of small tetragonal or plates of crystals. Upon covering a fragment on a slide with a watch crystal and cautiously heating crystals of benzoic acid are sublimed on the watch crystal.

484. *Elaterium.*—Grayish and grayish-brown, more or less opaque and irregular fragments. Heat fragment with phenol, and when cool add H_2SO_4, a deep red coloration is produced. KOH has no action on elaterium.

485. *Goa Powder.*—Small, somewhat transparent, wine-colored, irregular angular fragments. With KOH a bright, reddish color produced.

(β). *Become more or less transparent in glycerin.*

486. *Aloes (Barbadoes).*—In a glycerin mount the particles become clear and behave like Cape aloes, but generally numerous acicular or large prismatic crystals remain or separate in clear yellow space where fragment of aloes was originally.

487. *Aloes (Socotrine).*—In a glycerin mount the fragment is not very perceptibly affected. At the most there is but a faint yellowish color around the grayish or grayish-brown masses. In old Socotrine aloes the gray masses look like rosette crystals.

488. *Catechu.*—Large opaque dark brownish-red masses which on the edge gradually become transparent and dissolve with a sherry wine color, also fragments of sklerenchyma.

489. *Kino.*—Fragments become clearer and a deeper red (port wine color) compared to catechu.

GROUP NO. 5. COLOR REDDISH.

Kino, Cochineal (black), Cochineal (gray), Lupulin (old), Macis, Myristica, Capsicum, Crocus, Carthamus, Santalum rubrum, Krameria, Sanguinaria, Pine shavings, Breakfast cocoa, Illicium, Sassafras, Lupulin (new), Rosa gallica, Pulv. Rhei. Comp., Hufland's Baby Powder.

I. ANIMAL FRAGMENTS (TEST BY BURNING).

490. *Cochineal.*—Carmine red color in mounts of glycerin or glycerin + chloral.

II. VEGETABLE FRAGMENTS.

A. CONTAINING STARCH.

a. Containing calcium oxalate crystals.

491. *Krameria.*—See No. 279.

492. *Hufland's Baby Powder.*—Fragments of Rheum, MgO and sugar. See No. 278.

493. *Pulv. Rhei. Comp.*—Fragments of Rheum, ginger and MgO. See No. 257.

b. Few or no Calcium oxalate crystals.

494. *Cocoa.*—See No. 386 and 545.

495. *Capsicum.*—See No. 306.

496. *Myristica.*—Starch grains (5–7 μ) generally in groups; numerous oil globules; parenchyma and "Hullperisperm," with reddish colored contents; in "Hullperisperm" some prismatic crystals; some tetragonal or prismatic crystals (5 x 10 μ) of myristic acid, which are soluble in KOH; heat powder in chloral get tabular or acicular crystals. Myristica distinguished from *Mace* in that latter has no starch, and on treatment with KOH the secretion cells of Mace are colored blood-red, whereas, Myristica becomes brownish.

497. *Sanguinaria.*—See No. 312.

498. *Sassafras.*—See No. 313.

B. WITH LITTLE OR NO STARCH.

a. Containing Calcium oxalate crystals.

499. *Cocoa.*—See No. 386 and 545.

500. *Illicium.*—See No. 356.

501. *Santalum rubrum.*—Hexagonal or coffin-shaped crystals (15 x 25 μ) in crystal fibres; long sklerenchyma fibres, 10 μ wide;

ducts (150 μ wide) with bordered pores; all cell walls colored yellowish-red; some cells contain reddish granular resin-like masses. Distinguished from other woods possessing red dye in only possessing one row of medullary ray cells (in hæmatoxylon the medullary rays are 4–5 cells in width) and coloring matter not dissolved by water.

III. NO VEGETABLE OR ANIMAL TISSUES.

502. *Kino.*—See No. 489.

GROUP No. 6. CONTAINING POWDERS THAT ARE RELATIVELY COARSE.

Sugar (granulated), Sago (imitation), Sago (real), Grits (corn), Corn Bran, Quillaja, Orris Root (Florentine), Viburnum opulus, Sarsaparilla (Mexican), Sarsaparilla (Honduras), Taraxacum, Mezereum, Strophanthus, Linum, Dulcamara, Sinapis nigra, Humulus, Matricaria, Triticum, Sassafras medulla, Sweet Orange Peel, Terebinthina, Manna, Canella alba, Colocynthus, Sambucus, Pepo, Amygdala dulcis, Amygdala amara, Berberis aquifolium, Asafetida, Myrrha, Gentian, Rheum, Frangula, Anise, Black Mustard Hulls, Cannabis Indica, Cardamom (seeds hulled), Syr. Trifol. Co., Arnicæ Flor., Chirata, Staphisagria, Cocculus, Zea (corn silk), Juniper, Coffee, Pix Burgundica, Confect. Rosæ, Rubus idæus, Lactucarium, Juglans, Mylabris, Rhus glabra, Hæmatoxylon, Chicory, Stramonii Semen, Tea, Cochineal (black), Cochineal (gray).

I. CONTAINING NUMEROUS VEGETABLE FRAGMENTS.

A. CONTAINING STARCH.

a. Containing crystals of calcium oxalate.

a. Crystals rosette or star-shaped.

503. *Canella alba.*—See No. 244.

504. *Frangula.*—See No. 274.

505. *Juglans.*—See No. 251.

506. *Rheum.*—See No. 215.

507. *Syr. Trifolii Comp. (Powder).*—See No. 263.

β. Crystals cubical, tetragonal, prismatic or more or less coffin-shaped.

508. *Berberis aquifolium.*—Crystals cubical (4 x 4 μ); starch in

single (2 x 2 to 5 x 7 μ) and 2 to 3-compound grains; libriform fibres 30 μ wide; all tissues light yellow and very hard and resistant.

509. *Cardamom.*—See No. 23.

510. *Frangula.*—See No. 274.

511. *Iris Florentina.*—Crystals either like in quillaja very long and 10–20 μ wide, or long needles; starch characteristic (15 x 30 to 15 x 15 μ); parenchyma; no cork; fibrovascular tissue.

512. *Juniperus.*—Crystals hexagonal (30 x 30 μ) in stone cells which are 60 x 60 and walls 15 μ thick; small amount of starch (5–7 μ); oil secretion reservoirs; brown pigment cells.

513. *Myristica.*—Crystals are of myristic acid. See No. 496.

514. *Quillaja.*—See No. 284.

515. *Syr. Trifolii Comp.*—See No. 263.

516. *Viburnum opulus.*—See No. 287.

γ. Crystals acicular.

517. *Cocculus.*—Crystals are soluble in alcohol and not in dilute acids. See No. 547.

518. *Iris Florentina.*—See No. 511.

519. Sarsaparilla.—See No. 40.

δ. Crystals in fine sand ("crystal sand").

520. *Dulcamara.*—Numerous starch grains (7 μ); ducts reticulated 55 μ wide or with bordered pores (35–45 μ) associated with libriform cells 4 μ thick; cork; all elements gray or yellowish-gray color.

(*b*) Containing starch but no calcium oxalate crystals.

521. *Chenopodium.*—See No. 108.

522. *Corn Bran.*—Less parenchyma containing characteristic grains of corn starch but more fragments of coat (bran); oil globules.

523. *Grits.*—More or less altered and unaltered starch grains; almost free from coat (bran); oil.

524. *Mezereum.*—Starch in single grains (7–10 μ) or in masses; numerous very long colorless bast fibres about 15 μ wide; light parenchyma; yellowish-brown or pinkish cork.

525. *Myristica.*—See No. 496.

526. *Orris Root.*—Starch of varying but rather characteristic shape (15 x 15 to 15 x 30 μ); may find tetragonal (20 μ wide) or acicular crystals; fibro-vascular bundles; no cork.

527. *Pepo.*—Few starch grains (2 x 2 to 3 x 4 μ) occur in outer epidermis and endosperm; characteristic, pear-shaped, thick-walled

(possessing simple pores) cells about 70 x 45 μ; yellow pigment cells of seed coat; oil and protein in embryo.

528. *Sago* (*True*).—Slowly affected by cold water when there separates the characteristic elliptical, or truncate-elliptical starch grains (15–20 μ).

529. *Sago* (*Imitation*).—Breaks down quickly in water and shows characteristic *corn starch* grains.

530. *Strophanthus.*—Starch grains (4 μ) characteristic; long non-secreting hairs (10 to 15 μ wide); narrow, almost colorless, collapsed cells and parenchyma containing starch, oil and aleuron; with H_2SO_4 should become green, indicating fresh and unimpaired strophanthus.

B. WITH LITTLE OR NO STARCH.

a. Animal tissues.—On burning fragment on platinum foil gives off odor of burning tissue.

(*a*) *Does not color glycerin.*

531. *Cantharis.*—Green metallic particles; not hairy.

532. *Mylabris.*—Very hairy.

(*b*) *Gives a carmine-red color to glycerin.*

533. *Cochineal.*

(*b*) Without starch but containing vegetable tissues.

a. With Secreting or non-secreting Hairs.

534. *Anisum.*—See No. 8.

535. *Arnicæ Flores.*—See No. 373.

536. *Cannabis Indica.*—Characteristic crystoliths, with or without broad base attached, in latter $CaCO_3$ in a granular mass. Entire crystolith about 200 μ long; oil secretion hairs; rosette-shaped calcium oxalate crystals (20 μ); characteristic cells of pericarp.

537. *Humulus.*—Characteristic secreting hairs (Lupulin); numerous rosette-shaped calcium oxalate crystals (8 μ); non-secreting hairs; characteristic epidermis; ducts yellowish.

538. *Rhus glabra.*—Hairs may be numerous, long, broken, 1-celled or spatulate (consisting of a chain of cells), containing a red pigment dissolved; pigment cells; characteristic stone cells of pericarp (20 μ in diameter and walls 4–10 μ thick); oil and protein.

539. *Rubus idæus.*—Characteristic long, more or less curved, 1-celled hairs (7 μ diameter), containing a reddish pigment; loose parenchyma, containing pigment and rosette-shaped crystals of calcium oxalate (7 μ); also characteristic hairs of receptacle and calyx.

540. *Strophanthus.*—Starch grains might be overlooked as small grains and in small amount. See No. 530.

541. *Tea.*—Characteristic stone cells (idioblasts); numerous long, non-secreting hairs (10 μ wide); rosette-shaped crystals of calcium oxalate (10 μ); characteristic stomata (28 x 28 to 30 x 35 μ), with 4 or 5 "Nebenzellen"; adulterants are distinguished by possessing chiefly other forms of calcium oxalate crystals and hairs. (See also Mœller.)

β. Sklerenchyma cells (i. e., stone cells).

542. *Amygdala Amara* and 543. *Amygdala Dulcis.* Characteristic lignified yellow epidermal cells (70 x 65 μ), the walls of which are 4 μ thick and possess simple pores; endosperm layer 15 x 15 μ; crystals, may be rosette-shaped or cubical, about 7 x 7 μ and occur near the ducts; or there may be acicular crystals, 40 μ long. Bitter almond distinguished by putting a few fragments in cold water for some hours, when odor of HCN develops; or take solution and add $(NH_4)_2S$, evaporate in a porcelain dish nearly to dryness, and add Fe_2Cl_6 = a deep blood-red color.

544. *Black Mustard Hulls.*—Consist chiefly of characteristic fragments of seed coat.

545. *Cocoa.*—Consists chiefly of protein grains and oil; starch grains 4–8 μ; fragments with brownish contents (cacao red); fat crystals in little prisms or needles; few fragments of seed coat, consisting of hexagonal epidermal cells, a peculiar mucilage layer of small tabular cells and a layer of nearly isodiametric stone cells (10 x 10 μ), whose walls are 4 μ thick.

546. *Cocoa Shells.*—Chiefly of fragments of seed coat. See No. 545.

547. *Cocculus.*—Characteristic reddish-brown pericarp with elongated stone cells of varying shape, but walls about 7 μ thick; crystals either needle-shaped (single or in groups about 35 μ long) or prismatic (10 x 100 μ long), soluble in alcohol, but not in acids.

548. *Coffee.*—Characteristic fragments of seed coat, consisting of altered parenchyma and spindle-shaped stone cells (35 μ wide and 175–200 μ long); most cells are those of endosperm, with thick (10 μ) porous brownish-colored walls, the contents are oil, aleuron and starch. In commerce coffee generally either "straight" or artificial. Latter consists of cereals, chicory, etc.

549. *Colocynthis.*—Stone cells of fruit, 70 x 50 μ, the walls of

which are 15 μ thick; characteristic, nearly isodiametric, thick-walled stone cells, with but small lumen; the cells of embryo contain oil and aleuron. The amount of seed in powder is determined by number of oil globules and fragments of seed coat. The U.S.P. directs only pulp, not seeds or epicarp.

550. *Cydonium.*—Without starch or calcium oxalate; characteristic seed coat consists of an outer layer of clear mucilage cells, as in linum, beneath these are cells with thick walls and contain a pigment reacting like tannin; parenchyma contains oil, protein and tannin.

551. *Linum.*—Numerous fragments, possessing characteristic tabular reddish-brown pigment cells; when seen in surface view (15 x 30 μ) associated with small yellowish-colored stone cells; mucilage layer prominent, being the outer epidermis; relatively thin-walled parenchyma, containing oil and aleuron.

552. *Pepo.*—See No. 527.

553. *Sinapis Alba* and 554. *Sinapis Nigra.*—No starch, tannin or crystallizable carbohydrate; mucilage layer not so prominent as in cydonium or linum; much oil and aleuron (latter in small grains); not infrequently find complete transverse sections of seed coat in the powder. In *Sinapis alba* the coat consists of hexagonal epidermal cells (45 μ); then follows a sub-epidermal collenchyma, a light yellowish or colorless pigment layer and a layer of stone cells (8 x 10 μ), the walls of which are 4 μ thick. In *Sinapis nigra* the unequal hexagonal epidermal cells are larger, 45–70 μ, the pigment layer is reddish-brown and stone cells are about as in Sinapis alba. Both mustards are turned blood-red in color by H_2SO_4. Likely to find fragments of turmeric in yellow mustard.

555. *Staphisagria.*—Characteristic fragments of seed coat with brown pigment and possessing prominent hexagonal stone cells (80 μ wide) with thick walls (20 μ); long spindle-shaped cells, such as occur in delphinium are present; parenchyma contains oil and aleuron.

556. *Stramonii Semen.*—Peculiar greenish fluorescence of mount

in glycerin or glycerin + chloral. Nothing behaves like this. Characteristic seed coat, with yellowish and brownish thick-walled stone cells; most characteristic are the groups (of train-like) brownish stone cells, whose walls are very thick, with scarcely any lumen sometimes; parenchyma contains oil and aleuron, but *no* starch.

γ. sklerenchyma fibres.

557. *Berberis aquifolium.*—Ducts (50 μ wide), with bordered pores, wood fibres (20 μ wide, walls 8 μ thick) and medullary rays (9 rows wide, containing starch grains 10 μ) are yellow; bast fibres 15 μ wide and walls 4 μ thick; cork prominent; parenchyma of cortex contains brownish-colored substance.

558. *Chicory.*—Inulin masses; characteristic cork; numerous fragments of ducts of varying size; parenchyma (25 x 140 μ); laticiferous vessels 7–20 μ wide.

559. *Chirata.*—No starch; pollen grains (4 x 10 to 7 x 10 μ); parenchyma large, with simple pores; spiral and scalariform ducts (30 μ wide); numerous sklerenchyma fibres (20 μ wide and walls 4 μ thick); yellowish epidermis with brownish-colored collenchyma beneath; seeds reticulate and in shape like hyoscyamus; mycelial-like development containing dark-brown-colored substance.

560. *Hæmatoxylon.*—Cubical crystals (20 μ) in crystal fibres associated with yellowish libriform fibres (15 μ wide and walls 4 μ thick); large ducts (140 μ wide) containing brownish masses; medullary rays are 4–5 cells wide; characteristic violet or purple coloration with alkalies; oil globules, resin and tannin masses.

561. *Matricaria.*—Numerous nearly spherical pollen grains (18–25 μ); fragments of corolla with secretion hairs; cells of anther; stigma with papillæ; peculiar ladder-like cells of wall of akene; sklerenchyma fibres of involucral scales.

562. *Pine Shavings.*—Characteristic tracheids with bordered pores.

363. *Taraxacum.*—Characteristic laticiferous vessels and inulin. See No. 165.

564. *Triticum.*—Without starch or calcium oxalate crystals; parenchyma containing irregular masses, soluble in water (sugar); yellow hypodermal cells with lignified thickening (walls 10 μ or more thick) and simple pores; three kinds of characteristic sklerenchyma of varying length and width; some of the fibres are marked here and there, apparently at regular intervals, with a tabular cell (duct) of same composition as fibre; ducts spiral and annular (30–50 μ in diameter).

6. Sklerenchyma cells or fibres wanting.

565. *Aurantii Amari Cortex.*—See No. 206.

566. *Aurantii Dulcis Cortex.*—See No. 207.

567. *Gentian.*—See No. 467.

568. *Limonis Cortex.*—See No. 208.

569. *Sambucus.*—Numerous smooth pollen grains (18 x 18 μ); cells of anther; sometimes find small crystals of calcium oxalate in calyx; fragments of corolla with characteristic slight, dentate, papillæ; in flower stalk are large spiral ducts (30 μ diameter); also parenchyma, with brown contents and collenchyma.

570. *Sassafras Medulla.*—Consists only of parenchyma cells, whose walls consist of cellulose and mucilage, and hence swell perceptibly in water. Mount sticky, mucilaginous.

571. *Taraxacum.*—Characteristic (not lignified) "Ersatzfasern," laticiferous vessels and inulin. See No. 165.

572. *Zea.*—Style with spiral and annular ducts, and from the epidermis there arises secretion hairs which are 300 μ long.

II. CONTAINING FEW FRAGMENTS OF TISSUES.

A. POSSESSING OIL.

573. *Asafetida.*—In a glycerin mount the powder shows irregular grayish (or gray streaked with brown) masses; opaque and becoming milky white on edge from oil. The *Stony* asafetida is pulverulent and contains less oil.

574. *Myrrh.*—In glycerin mount powder appears in yellowish or yellowish-brown irregular fragments made up of a grayish matrix and containing yellowish or yellowish-brown oil globules.

B. NO OIL; AND GLYCERIN MOUNTS NEARLY TRANSPARENT.

575. *Manna.*—Collection of long, transparent tetragonal or prismatic crystals of varying length and about 4 to 10 μ wide; fragments in glycerin leave clear crystal and little amorphous opaque residue.

576. *Pix Burgundica.*—More pulverulent (M. P. lower) than Terebinthina; lemon-yellow transparent, or grayish, somewhat translucent, more or less rounded and opaque masses. Soluble in glacial acetic acid, giving a yellowish-brown solution.

577. *Sugar.*—Like rock candy; dissolves in glycerin without residue.

578. *Terebinthina.*—More adhesive (softer in summer) than Pix Burgundica; nearly transparent colorless or light yellowish masses of irregular rounded outline. Solution in glacial acetic acid of a light yellow.

C. NO OIL, AND MOUNTS IN GLYCERIN MORE OR LESS OPAQUE.

579. *Confectio Rosæ.*—Fragments of red rose petals with characteristic more or less rounded papillæ; few elliptical pollen grains (18 x 32 μ); mass grayish and made up of rounded grains; some transparent sugar crystals.

580. *Lactucarium.*—Grayish brown and dark brown, irregular and rather angular masses; with alkalies they become reddish brown and then a dirty brown; with H_2SO_4, but slightly (faint yellow) affected.

NO. 7. VEGETABLE (ALSO ANIMAL) DRUGS WHICH DO NOT OCCUR IN POWDERS BUT IN MASSES OR LIQUIDS.

I. LIQUIDS.

581. *Balsam Peru*—Color blackish.
582. *Copaiba.*—Color amber.
583. *Gurjun Balsam.*—Color amber.
584. *Mel.*—Colorless or faint yellow.
585. *Styrax.*—Peculiar gray color.

II. SEMI-FLUID OR NEARLY SOLID.

586. *Bals. Tolu.*—Characteristic odor.
587. *Prunum.*—Characteristic tissues of pericarp and seed.
588. *Resina Podophylli.*
589. *Tamarindus.*—Characteristic tissues of pericarp and seed.

III. SOLID.

590. *Elastica.*—Not pulverulent.
591. *Resina Podophylli.*

REMARKS.

This investigation, which has occupied the attention of the author for several years, is based on the careful study of the crude (sometimes also fresh) drug as well as authentic commercial powders

(some of these have been furnished by Gilpin, Langdon & Co.) and in many instances drugs ground by the author.

In publishing these results at this time no one realizes more than the author that the whole scheme is but tentative and that additional study and the application of the method outlined will, no doubt, cause some changes to be made in practice. It would be surprising, furthermore, if there are not some errors of either commission or omission in that in some cases the characteristics given or withheld may be due to the examination of diseased, deteriorated or even spurious drugs. But all this is due to the fact that the collecting and caring for drugs is not carried out on scientific principles. Even should there be oversights or errors, the publication of this work must be of some value to pharmacognocists. We must realize that a communication of this kind to be complete in any sense must have incorporated with it the results and experiences of numerous investigators from rather widely scattered sections of the country and world.

The scheme is based on scientific principles, but it has been considered desirable at the outset to open up the subject by dividing the powders into groups depending on their color. It is true that color varies in the plant itself in nature and according to the time of gathering, mode of collecting and subsequent treatment, exposure to light, etc. But it is very necessary that these things be thoroughly studied before we are prepared economically to properly exhaust drugs, make preparations and pronounce on the therapeutical value of them. In this connection, it must be stated that in the study of powdered drugs the education of the eye to color is very important, and, indeed, necessary. Old and freshly-powdered drugs are to be distinguished by this means alone, as also a properly prepared drug from one carelessly treated. To the author's mind the eye and nose, and possibly the taste are very important factors in the study of powdered drugs in connection with the microscope.

A number of interesting features have been brought out in this investigation. In fact it opens up possibly an entirely new method in the study of our drugs at large.

(1) In the first place, in the color of the powder certain characteristic and diagnostic features are brought to light. Leaf and herb drugs in the powdered condition should be greenish or grayish, and not blackish or brownish-black; many roots and rhizomes ought to

be a light tan rather than a dark brown, etc. The value of Taraxacum and other more or less important drugs rich in reserve materials, as inulin, starch, etc., may be ascertained, as these reserve materials are contained, no doubt, in greatest abundance in the plant at the time that the active medicinal agents are present in likewise greatest amount.

(2) Certain facts, as the presence of pollen grains in Chestnut leaves will cause us to go into the woods and study the ecological and biological relations of the plants which yield us our drugs. For, without this study upon Nature herself, we shall never know what value to place upon such observations or their real significance.

(3) The presence of reserve starch in leaves and a diminution in calcium oxalate in any part of the plant where normally it is present, will cause us to open our eyes to the study of micro-organisms and inquire as to what these things have to do with the deterioration of drugs and the spoliation of medicinal preparations.

When these pharmacognostical problems are understood then we will cease to devote our energies to indiscriminately mixing certain things together in our attempts to make elegant pharmaceutical preparations, but will start out to know what causes the difficulty; and, knowing this, we know how to proceed intelligently and in a scientific manner, just as we proceed in certain chemical-pharmaceutical work.

(4) The use of the microscope in the examination of vegetable drugs (whether they be crude or powdered), as also in the examination of animal substances and chemical compounds, is an application of this instrument to a degree that this communication indicates—to some extent at least—the widest practical application. In fact, it opens up the necessity for making microscopical examinations and micro-chemical tests to a much greater degree than heretofore on the crude as well as powdered drug.

The author would impress again upon all investigators the necessity for accurate measurements of tissues and contents of materials which are studied; as also the name of the media or reagent in which the specimen lies or to which it has been subjected. KOH, chloral, glycerin, etc.—all of these have the property of affecting the thickness and character of the cell walls and cell contents, and it is upon these characteristics that we must rely for our useful studies of crude and powdered drugs.

EDITORIAL.

WAR REVENUE BILL.

It is more and more evident that the subject of taxation requires the undivided attention of statesmen and lawmakers possessed of unusual ability and judgment, and which have been accumulated by reason of large experience and opportunities for study. It is more apparent that party lines must cease on measures of such great economic importance as concern every citizen of the Republic. The tariff may be likened to a lock in a canal, which must be adjusted from time to time to meet the tide of necessity and nothing else. At certain times, as when the nation is at war, the supply from the upper canal must be in proportion to meet the outflow. The lock must be adjusted so that the income will meet the outgo. If necessity for the latter for any reason ceases (as when peace is declared), and the lock is not adjusted for the conditions existing, there must be an overflow. The overflow is as disastrous as the drought. The principle of "no tax except there be public necessity" is as immutable a law of this Republic as the declaration of Alexander Hamilton "that a complete power to procure a regular and adequate source of revenue, as far as the resources of the community will permit, may be regarded as an indispensable ingredient in every constitution."

We have already referred to the necessity of our Government providing means for an increased revenue, and to the precedent which was followed. No comment was made at that time, as we felt that whatever views we might have under the existing conditions, it was the duty of us all to stand by our country in its hour of need. Since that time conditions have changed. Peace negotiations are in progress, the war is virtually at an end, and "the excessive expenditures of the past few months must necessarily very speedily cease." In a report by A. Cressy Morrison, made at the recent meeting of the N. W. D. A., at St. Louis, in which the figures are based upon the official report of the Treasury Department we learn that: "The average normal expenditure for the years 1895, 1896 and 1897 was about $357,000,000 per year. This does not, of course, include the outlay of the postal service, which is about offset by the receipts from that source. It is fair to assume that this average yearly expenditure will be permanently increased, to a certain extent, by the results of the war. Suppose we estimate this permanent yearly increase at $43,000,000 (which is more than any believe it will be), you have a gross yearly expenditure of $400 000,000 to provide for.

"Now let us turn our attention to the receipts from taxation, and ascertain what revenue is coming in to meet this $400,000,000. We can only base our argument and suggestions upon the receipts for the first three months of the present fiscal year, viz., July, August and September, 1898. Taking these months, the showing is as follows:

FEDERAL REVENUE.

	1896.	1897.	1898.
Receipts from Customs	$12,157,330	$16,966,801	$15,169,680
(July) Internal Revenue	14,302,532	19,707,831	26,170,697
Miscellaneous	2,569,346	2,292,730	2,506,730
Receipts from Customs	12,329,495	6,987,702	16,249,699
(August) Internal Revenue	11,961,338	11,193,194	24,015,934
Miscellaneous	1,271,262	842,717	1,517,073

	1896.	1897.	1898.
Receipts from Customs	$11,374,116	$7,943,100	$16,759,574
(September) Internal Revenue	11,679,136	12,701,975	21,555,283
Miscellaneous	1,530,991	1,288,022	1,463,207
The three months enumerated are those in which Government revenues are lightest. A careful examination and estimate, based upon comparisons of the receipts for July, August and September, 1898, with previous years, indicate that the monthly receipts from customs will be about $17,000,000, or for the fiscal year . .			204,000,000
From Internal Revenue, $24,000,000 per month, or for the fiscal year			288,000,000
From miscellaneous receipts, $2,000,000 per month, or for the fiscal year			24,000,000
Making a total revenue of			$516,000,000
Deducting from this the estimated expenditures for the fiscal year			400,000,000
And we have left a surplus revenue of .			$ 16,000,000

"Already the available cash balance in the Treasury has reached the enormous amount of over $300,000,000. The Secretary of the Treasury is put to his severest efforts to prevent such large withdrawals of currency from the channels of trade. The Spanish War gave him a chance to unload some of this surplus, to meet the emergency expenses, but that war is over, and soon all bills contracted therefor will be paid. There would seem to be no other course left open but a reduction of internal taxation. Among the subjects of taxation resorted to by the War Revenue law of 1898 there are several which will undoubtedly be permanently taxed, such as legacies and successions, sales of stock in Wall Street, the increased tax on beer and tobacco and one or two others. It therefore becomes a matter for your thoughtful consideration whether you should not make every possible exertion to get your stamp tax reduced, if not altogether repealed.

"The sudden termination of the war has not only left the Treasury with those enormous receipts from internal taxation, but the Secretary finds himself with $200,000,000 in cash realized from the sale of bonds, and this cash must, by the terms of the law, be applied to meeting the war expenses, and nothing else. He will, consequently, use these funds in preference to the receipts from taxation. This amount will be ample to cover the entire outlay requi ed, and an annual surplus of $116,000,000 will continue unchecked, unless Congress shall wisely repeal some portion of the war revenue law."

It would appear that the revenues of the Government by reason of the revenue bill and sale of bonds are more than are needed for the purposes for which they are intended. It is further apparent that the business of the pharmacist, particularly that of the retail druggist, is singled out from all other business interests in bearing this burden. He pays his share of the war expenses along with every other business concern by stamping their checks, telegrams, insurance policies, express receipts, legal instruments, etc., etc., and the special tax on medicines is just that much more than should be levied on the drug trade, and should be removed. There was no reason in the first place why manufacturers, of various protected articles, who are enabled by governmental

protection to secure extraordinary profits should not have contributed their share with the manufacturers of protected medicines. But the conditions as they prevail to-day should cause the absolute repeal of Section 20.

"Several weeks ago Commissioner Scott, according to *Bulletin of Pharmacy*, asked the collector of each district to make a careful observation of the workings of the tax and to send in his opinion concerning the changes which would make the act less burdensome and unjust, less hampering to business, and less provocative of friction and annoyance. The answers to this request will form the basis of the Commissioner's report to Congress, and Congress will, no doubt, be largely influenced by the Commissioner's findings." Now, if the stamp tax is to remain, it ought to be reconstructed, and that with justice to all business enterprises. "But why, forsooth, should it remain in existence? The policy of our country is against the imposition of any tax which is not warranted by public necessity." So great is the injustice of the present bill to the retail pharmacist and so perplexing are the interpretations of the local collectors and further confusing the rulings from the Washington Department, that the *Western Druggist* says: "The vexatious complications arising from the new war revenue act appear to be increasing in number daily, until it would seem that the retail druggist is veritably between the devil and the deep sea in his efforts to comply with the requirements of the law and at the same time save himself from being plundered to the point of bankruptcy." Let us hope that Congress will speedily reconstruct, at least, if not repeal, the law as relating to the retail druggist and manufacturer of medicines.

REVIEWS AND BIBLIOGRAPHICAL NOTICES.

A TEXT-BOOK OF CHEMISTRY. Intended for the use of pharmaceutical and medical students. By Samuel P. Sadtler, Ph.D., F.C.S., Professor of Chemistry in the Philadelphia College of Pharmacy; author of "A Hand-Book of Chemical Experimentation," "A Hand-Book of Industrial Organic Chemistry" and Chemical Editor of "The United States Dispensatory." And Henry Trimble, A.M., Ph.M., Professor of Analytical Chemistry in the Philadelphia College of Pharmacy; author of "Practical and Analytical Chemistry" and of a monograph on "The Tannins." Second revised and enlarged edition. In two volumes. Vol. II, Analytical Chemistry and Pharmaceutical Assaying. Philadelphia: J. B. Lippincott Company. London: 66 Henrietta Street, Covent Garden.

The handy volume of 336 pages before us is a material enlargement of Part V of the first edition of this work. Many subjects important to the operating scientific pharmacist which would have added considerably to the bulk of the one volume of the first edition, together with many valuable experimental details, are incorporated in the present book. The subject matter of this volume, which deals with analytical chemistry and pharmaceutical assaying, is divided into five parts.

Part I of sixty-five pages is an admirable, condensed treatise on the qualitative analysis of bases and acids, including some organic acids, *e. g.*, tartaric, benzoic, tannic acids, etc. This part is carried from the first edition with a few slight alterations or additions.

The uniform use of formulæ to express the names of reagents not only

effected much economy in space, but is also of value to students of this phase of the science. An excellent feature of this part of the book is seen in the analytical charts appended to each group of bases.

The second part, or quantitative analysis, covers 128 pages, and describes both gravimetric (68 pp.) and volumetric (60 pp.) processes.

While the first edition by necessity (owing to the entire work being in one volume) contains only a few illustrative examples of gravimetric analyses, the present volume describes in detail the quantitative determination in simple salts of every basic and of the more important acid radicals touched upon in Part I. This selection is made with judicious reference to the needs of the pharmacist. Thus we find in the list bismuth, cerium, arsenic, mercury, hypophosphites, sulphites, cyanogen, silicates (seven pages), acetates, tartrates, citrates, etc. Often one substance is weighed in more than one form, *e. g.*, arsenic (in arsenic compounds) as As_2S_3, and as ammonium magnesium arsenate, or bismuth in the form of Bi_2S_3, Bi_2O_3 and metallic Bi. The directions given in each case testify to the painstaking care of the authors.

Of course, no attempt is made to describe quantitative analysis of mixtures, although the assay of simple alloys and ores is considered. The authors (p. 73) properly suggest that the student should master the qualitative course of analysis in order to make himself able to personally devise some plan of quantitative separation, which is certainly a suggestion conducive to intelligent analytical operation.

In the part devoted to volumetric processes we find the most important test solutions enumerated, and their mode of preparation is also stated. The making of volumetric solutions is described, mostly in the language of the U. S. Pharmacopœia, and the several principles of volumetric assay are expounded in direct connection with the description of the volumetric solution which is used in the respective reactions.

Explanatory details are given in each case both regarding the reaction involved and the special experimental phenomena to be observed in the application of the assay under consideration. In this connection, for example, the treatise on Fehling's Solution (pp. 191–196) is a typical example.

Part III (61 pages) considers pharmaceutical assaying, and comprises the estimation of moisture and ash in organic drugs (pp. 204–207), alkaloidal assay by various methods (pp. 208–226), with special examples such as the assay of opium and its preparations, certain iron scale compounds, etc., as well as miscellaneous assays, such as the assay method of cantharides by Baudin, of pepsin, diastase, formaldehyde, etc.

In this part are furthermore considered gasometric estimations of the U.S. Pharmacopœia, the determination of some physical constants such as specific gravity, solubility, melting and boiling points, optical rotation; the quantitative determination of the alcoholic strength of spirits, the acidity, extractive and ash of certain fluids, and the determination of glycerin in aqueous and alcoholic liquids, including the method of Benedikt and Zsigmondy.

Part IV gives in twenty-seven pages a useful treatise on the analysis of urine and urinary calculi, including the testing for albumen (272–276), sugar (278–285), etc., etc.

Part V in twenty-eight pages, treats of special processes, such as water analysis (289–304), milk analysis (305–308), and the estimation of nitrogen.

An appendix contains a table of atomic weights, Squibb's alcohol table and the pharmacopœial rules for reducing the percentage of alcohol to any given strength by admixture of water.

The book is clean and free from typographical errors, but on p. 71 the change of the reference, "page 859," was overlooked, and on page 177 the various subheadings, which treat of the employment of volumetric solution of potassium permanganate might be made more conspicuous.

A well compiled index of eighteen pages adds to the ready usefulness of the book.

To sum up, Volume II now before us as might be expected from the hands of Professors Sadtler and Trimble, is a well-poised and admirable treatise on Analytical Chemistry and Pharmaceutical Assaying.

Any student in pharmacy, whether a beginner or experienced in that art, may follow it with confidence and profit. Results of personal experimentation and details of manipulation are not often recorded in text-books with the faithfulness and exactness we find in this volume. We commend the work as one that should be on the shelf of every assayist involved in pharmaceutical determinations.

JOHN URI LLOYD.

COMMERCIAL ORGANIC ANALYSIS. By Alfred H. Allen. Third edition, with revisions and addenda, by the author and Henry Leffman, M.D., Vol. I. Alcohols, neutral alcoholic derivatives, sugars, starch and its isomers, vegetable acids, etc. Philadelphia: P. Blakiston, Son & Co. 1898.

For the practical working chemist to whom the miscellaneous problems of commercial analysis are presented from day to day under a variety of forms, it is safe to say no work has proven of equal value with "Allen's Commercial Organic Analysis," and it is therefore certain to find a place on his reference shelf. The immense field covered in the plan has made it necessary to spread the work over four volumes, of which the third appeared in three parts, and as the author says in the preface to Volume IV, which has just appeared, "the production of the second edition of my 'Commercial Organic Analysis' has extended over fourteen years." So it happens that the second edition of this Volume I appeared in 1885, and has been out of print for several years. For this new edition Mr. Allen has furnished some new material, and Dr. Leffman, the American editor, has supplied still more.

Thus, under the subject of specific gravity, Dr. Leffman has introduced the Squibb specific gravity bottle in its latest form, and added a foot-note, explaining the difference in graduation of the Baumé hydrometer in England and in America, which is very helpful. With his complaint of the want of accuracy of the Westphal balance and inability to obtain satisfactory results with it, however, the writer is not able to agree, as for many volatile liquids it can be made to give more reliable results than any other form of apparatus.

Considerable use has been made of the published processes of the American Association of Official Agricultural Chemists, and much valuable information taken therefrom. Thus, the very complete discussion of the Kjeldahl process, the determination of fusel oil in spirits, the applications of polarimetry in urine analysis, and the examination of starch and glucose products are all valuable additions from this source.

The improved method for the determination of acetone, by Kebler, is given,

but under chloroform the only mention of acetone as a present commercial source of chloroform production is given in one line of a foot-note. On a later page (p. 235) the preparation of chloroform from wood spirit is spoken of with no intimation that it is the acetone in this and not the methyl alcohol that is responsible for any chloroform produced. Similarly, under iodoform, no mention is made of its later modes of production, such as from acetone, and direct from iodides with the aid of electrolysis.

The section on cellulose is in general satisfactory, as its recognition in woody tissue is well discussed, and its derivatives of the nitrate class are described, but we notice that no mention is made of Cross and Bevan's important work on the production of soluble forms of cellulose, such as viscose and similar substances.

Mention is made of the nature of celluloid and gun cotton, and the method of their analysis, but no account of the newer smokeless powders, or their composition and analysis is given. This would have added to the completeness of this section.

However, the work as a whole is so valuable and comprehensive that small deficiencies should not weigh too greatly. It is emphatically a useful book, and will undoubtedly maintain its foremost rank as a reference book for many years to come.

S. P. S.

MINUTES OF THE PHARMACEUTICAL MEETING.

PHILADELPHIA, November 15, 1898.

The meeting was called to order at 3 P.M., promptly, Mr. James T. Shinn acting as chairman.

The first paper read by Mr. W. L. Cliffe, Ph.G., upon "Product Patents from a Pharmaceutical Standpoint" (see page 596). Mr. Cliffe spoke of four classes of patents, obtainable in this country, *i.e.*, a patent for an art, machine, manufacture or composition of matter. Of these, the latter is the one considered by him at length, although he spoke of process patents also. Mr. Cliffe mentioned the acuteness displayed by German manufacturers who obtain product patents whenever possible; thus enabling them to reap tremendous profits from the sale of their products. Mentioning phenacetine as an example, the speaker stated that the cost of manufacture is about 10 cents per ounce, the selling price to the trade here being $1 per ounce. As the quantity sold in this country probably averaged 300,000 ounces per year during the life of the patent, the profits realized were enormous. Antipyrine was also mentioned as a notable example of the same injustice to American pharmacists.

In the discussion which followed Mr. Jos. W. England read an abstract from an editorial in the *Bulletin of Pharmacy* for October, which corroborated Mr. Cliffe's paper in many respects. Mr. Procter asked about the manner of importation, and was answered by Mr. Cliffe to the effect that it was not imported under the name, Phenacetine, and he did not know under what head it came in; an ad valorem duty on its cost of manufacture is imposed, which does not amount to much when compared with the selling price. Upon motion the author was thanked for his valuable paper, which was referred to the Committee on Publications.

Mr. England then read the following resolutions which he wished the members to consider:

WHEREAS, The United States Constitution, framed over a century ago, at a time when even the wonderful prescience of its makers could not have foreseen the conditions existing to-day, permits through Congress not only the patenting of processes for making remedial chemic l compounds, but also the patenting of the compounds themselves, by citizens and aliens alike; and

WHEREAS, This privilege of patenting products intended to encourage invention and develop native industries by affording a term-limited monopoly in the articles made and sold, has been seized upon by foreign manufacturers as a means of securing the exclusive sale of such products in the American markets—no native industry being developed; no native labor being employed—and at prices for the goods wholly out of proportion to their real worth and far in excess of those demanded in other countries; and

WHEREAS, This privilege is used alone to the advantage of foreign interests, and to the detriment of the American public and its interests; therefore, the Philadelphia College of Pharmacy in Pharmaceutical Meeting assembled,

Resolved, That we protest against the further granting of such a monopolistic privilege—not permitted in Germany, France or England—as one opposed to the genius of our patent laws and the interests of our people; and

Resolved, That we earnestly urge the members of the Patent Commission appointed by the President under Act of Congress Number 121, approved June 4, 1898—whose duty it is to submit to Congress, a report indicating 'Any proposed changes in the substance of the existing law;" the report to "be accompanied by notes which shall briefly and clearly state the reasons for proposed change"—to recommend that the privilege of patenting remedial chemical compounds be repealed, and, also, the practice of the United States Patent Office of copyrighting and registering for all time as the exclusive property of manufacturers, single names of compounds which by use become titles.

In the discussion which followed the reading of these resolutions Messrs. Boring, Lowe, Cliffe, Procter, McIntyre and England participated. Mr. England stated that it was his object to have the resolutions adopted and a copy forwarded to the Committee, who are now engaged in considering the revision of our patent laws, and who are to report to President McKinley in the near future. The resolutions were finally adopted as read, and a copy ordered to be sent as proposed. Mr. England made a motion, which was seconded and carried, that a copy of Mr. Cliffe's paper should accompany the resolutions sent to the Committee.

Mr. L. F. Kebler read a paper on "Medicinal Lithium Carbonate," which was offered as a contribution from the "Pharmacopœial Research Committee of the P.C.P." The paper was very interesting, and will be found in full in this JOURNAL (see page 600). The discussion which followed the reading was participated in by Messrs. Thompson, Shinn, Moerk and England.

Mr. Frederick L. Lewton then gave a talk upon Quebracho and its uses, which was of great interest, owing to the speaker's familiarity with the different aspects of his subject. His talk was illustrated by specimens from the Philadelphia Commercial Museums with which Mr. Lewton is connected. The paper will be published in a later issue of this JOURNAL. The following took part in the discussion: Messrs. Shinn, Haussmann, England, Lowe and Kebler.

The next paper was by Mr. Kebler, upon "Crystals of Sodium Chloride in Fld. Ext. Yerba Reuma, together with a proximate analysis of the plant." The paper will be published in full in a subsequent number of this JOURNAL. It proved very interesting and elicited quite a little discussion, to which Professors Remington and Moerk, and Messrs. Kebler and England contributed much information. Professor Remington, speaking with reference to the high ash content of the plant, which included 17 per cent. of sodium chloride, mentioned an experience of Dr. Squibb's in using a weak percolate repeatedly in manufacturing F. Ext. Valerian, and which finally became super-saturated with sugar,

which occurs in small proportion in the drug, so that a lot of the Fld. Extract which went out, deposited the sugar in crystals on the sides and bottom of the containers, causing complaints which mystified the operators until the cause was ascertained. Professor Remington also called attention to the occurrence of potassium nitrate in F. Ext. Henbane and potassium chloride in F. Ext. Belladonna occasionally.

The program for the afternoon was concluded by Professor Ryan, who gave a talk upon gelatine pearls and their manufacture. He exhibited the sheet of gelatine containing the filled pearls not yet cut apart, and also the perforated sheet from which the pearls had been cut out.

He spoke of the comparatively recent introduction of their manufacture into this country, and stated that the machinery employed was very expensive. The difference between a pearl and a capsule is that the former contains no air space and the latter does. They are made by pressing two sheets of gelatine together after having placed them on metallic plates having hemispherical depressions. The medicament is placed in the depressions on one of the sheets, which is held horizontally. The other is then pressed down upon it, having the depressions in perfect juxtaposition, so that their edges meet on both sheets. By the action of powerful presses the excess of medicament is forced out and the pressure seals the edges of the depressions on the two sheets, so they may be cut apart, forming the well-known pearls of commerce. Professor Ryan received much applause and was heartily thanked for his talk and exhibition of specimens.

Professor Lowe spoke of the peculiar leaf scars which he had referred to in an article in the AMERICAN JOURNAL OF PHARMACY for April, 1896, and which had been exhibited to the members at that time. He exhibited an additional lot, and stated that they were from white poplar.

Mr. Shinn asked whether all trees of this species showed this remarkable effect, which Professor Lowe could not answer with certainty.

Mr. Wallace Procter then spoke of the preservation of certain easily decomposable chemical salts, such as ammonium carbonate and unslaked lime, and said that he would recommend the use of Millville fruit jars of ½-gallon size for the purpose, as in his experience they had proven very satisfactory. Dr. Weidemann corroborated this from his own experience.

Mr. F. W. E. Stedem then asked whether the members present were accustomed to dispensing the red or straw-colored Elixir Curacoa upon prescriptions. Several members stated they used the N. F. preparation, which is the straw-colored one. Mr. Procter said he used Mr. Shinn's process for preparing the elixir by distilling spirits with the volatile oils of the aromatics used in its preparation.

Mr. Shinn stated that the process had been obtained by him from a French pharmacist, many years ago, who stated it to be the process for the genuine "Curacoa Cordial."

Mr. E. M. Boring spoke of some difficulties he had experienced in dissolving boroglyceride, after which the meeting adjourned.

The meeting was very well attended by many prominent members of the pharmaceutical profession and most of the Faculty.

CHARLES H. LAWALL,
Secretary pro tem.

NOTES AND NEWS.

Turpentine Vapor.—A fire was occasioned on the premises of a dealer in chemicals (*Chem. and Drug.*, 1898, p. 622) through an assistant going down the cellar with a naked light, which came into contact with the vapor of turpentine stored there. In a few minutes the whole house was in flames. Damage estimated at 25,000 *f.* resulted.

Preventive of Rust on Metal Work.—Lard 125 parts, camphor 20 parts are melted together and a little graphite added. The objects are dressed with this paste, which is removed after twenty-four hours.—*Chem. News*, 1898, 183.

Students' Insurance.—The University of Heidelberg has announced (*West. Drug.*) an innovation in the shape of accident insurance providing for all students attending its physical and chemical laboratories. While the University pays the premium, a small extra charge is exacted from each student.

Sadtler's Reducing Agent.—A slightly acid bath of hydrogen peroxide is used as a reducing agent for chrome tanned skins.—*Leather Manufact.*, 1898, p. 101.

Sterilized Water.—Bizzozero maintains that the taste frequently complained of in boiled water is really caused by the kettle and can scarcely be due to the absence of CO_2 or dissolved air, of which water from wells of great depth often contains very little.—*Pharm. Jour.*, 1898, 118; from *Practitioner*, LXI, 63.

Black Wax.—E. H. Blitz has examined a sample of black wax from the West Indies, and finds that the coloration is due to the pollen grains contained in the wax.—*Pharm. Zeit.*, 1898, 404.

Mushrooms as Food.—The report of the U. S. Department of Agriculture (Farmer's Bulletin, No. 79) compares the composition of mushrooms with that of other articles of food, and shows that edible fungi do not possess a high food value.

An Honor.—Dr. A. B. Griffiths has been elected an honorary member of the Medical and Surgical Society of Rio Janeiro, Brazil, in recognition of his researches in the ptomaines.—*Chem. News*, 1898, p. 144.

Essence of Mandarins.—J. Flatan and H. Labbé (*Bull. Soc. Chem. de Paris*) have found 98 per cent. of limonene in this essence, identical with that found in the essence of Portugal; a trace of citral, and about 1 per cent. of the same ether insoluble in alcohol were also present.—*Ibid.*, p. 160.

The Drug Market.—Geo. L. Muth, Chairman of the Committee on Drug Market of National Wholesale Druggists' Association, reported, among other things, that the importation of certain drugs has been very heavy. Quinine and its salts, 4,372,477 ounces, against 2,696,492 ounces previous year. Balsam copaiba increased 64,000 pounds in imports, while opium imports for fiscal year 1896 to 1897, 1,072,914 pounds, same 1897 to 1898, only 123,845 pounds, a big decrease, 949,069 pounds. The supply of many indigenous drugs was heavy, owing to big prices; others, where prices have been so very small, are not coming to market.

Acid, Boracic.—A slight advance during the year. There is very little news in regard to the California product, which promised so well a few years ago.

Acid, Tartaric.—This is usually a very fluctuating article in the drug trade; but, for past year, has been very steady.

Alcohol, Grain.—Again in the combine of the great Whisky Trust, and, of course, higher prices.

Alcohol, Wood.—Declined only for a short time. Sales are pretty large, it being freely used in the arts.

Arrow Root, Bermuda.—The true article quoted 42 to 45 cents in kegs; it is getting very scarce; the regular stock Bermuda, 25 to 30 cents in kegs. St. Vincent's, owing to tariff, is selling 7 to 9 cents, and American, 5½ to 7 cents.

Balsam, Copaiba.—As usual, this drug moves in many ways, having a big advance at the outbreak of our war with Spain. The imports from June, 1897, to June 30, 1898, were 196,571 pounds, an increase of 64,000 pounds over previous year.

Balsam, Canada Fir.—A slight advance only during the year.

Balsam, Peru.—Much more fluctuating than usual.

Balsam, Tolu.—Low price now ruling.

Bark, Cascara Sagrada.—The price has been very unsteady for new bark, 3 to 6¾ cents, and for old bark 8 to 10 cents; sales have been very large.

Bark, Cinchona.—Calisaya selling all the year from 15 to 22 cents, as to test.

Bark, Cinchona.—Red selling 12 to 18 cents, as to test. The imports for first seven months of this year nearly 600,000 pounds against 400,000 same time 1897.

Berries, Saw Palmetto.—This new drug may go to high figures; they nearly all come from Florida, and people, on account of the great number of soldiers being in the State, have more profitable employment, and will not gather them. Selling in October, 1897, at 6 cents; now (September, 1898), 10 to 12 cents.

Buds, Balm of Gilead.—Very fluctuating: selling 1897, October, 30 cents; 1898, January, 35 cents; March, 40 cents; May, 24 cents; July, 22 cents; September, 26 cents; October, 28 cents.

Beans, Tonka, Angostura.—Have declined very much; 1897, October, $1.60; 1898, March, $1.45 to $1.50; July, $1.25 to $1.30; September, $1.15 to $1.25 per pound, and Para Beans now selling 12 to 15 cents per pound; Surinam, 45 to 50 cents.

Beans, Vanilla, Mexican.—Have declined; 1897, $10.00 to $13.00 per pound; now (1898) selling $7.75 to $13.00 per pound, and cuts $7.25 to $7.50.

Beans, Vanilla, Bourbon.—Are much lower, quoted $4.50 to $7.00 per pound, as to quality.

Camphor.—For many years this has not been so steady as the past year, and sales have been very large.

Camphor, Japanese.—Has been steady.

Cantharides, Chinese.—Have advanced.

Cantharides, Russian.—Declined during the year.

Ergot.—Has only advanced slightly past year; 1897, German selling 14 cents; now (1898) at 18 cents per pound; and the Spanish, 1897, 18 to 20 cents; in September, 1898, selling 23 to 25 cents.

Flowers, Arnica.—Prices are very low, selling all the year from 5½ to 7 cents, as to quality.

Flowers, Chamomile, Belgian (Roman).—Have advanced.

Flowers, Chamomile, German.—A sharp advance only lately; 1897, October 16 to 20 cents; 1898, September, 22 to 28, and 35 cents for some very choice.

Flowers, Lavender.—A new demand has increased the sales, and now selling ordinary 3 to 4 cents, and select from 9 to 12 cents.

Glycerin.—Has been rather more regular in price.

Green Soap, German.—Government officials discovered that there is a duty of 15 cents per pound on this, and price was advanced very much, selling, 1897, October, 6 to 6½ cents; January, 22 to 24 cents. It is now being made in this country, and selling from 5 to 8 cents, as to quality; this is quotation in kegs.

Gum Arabic.—Has declined during the year; selling October, 1897, firsts, 55 cents; seconds, 34 cents; thirds, 27 cents; sorts, 17 cents; now, 1898, September, 48 to 50 cents; seconds, 32 cents; thirds, 27 cents, and sorts 16 to 17 cents.

Gum Aloes, Barbadoes True.—19 to 21 cents, and so-called in gourds, 5 to 6 cents.

Gum Aloes, Cape.—5 to 6 cents all the year.

Gum Aloes, Curacoa.—2½ to 3½ cents. This now has a large sale, said to contain the largest percentage of aloin of all the gums.

Gum Aloes, Socotrine.—20 to 24 cents, as to quality.

Leaves, Cocoa, Huanacoa.—1897, September, 15 to 17 cents; December, 21 to 24 cents; now selling at 20 cents.

Leaves, Cocoa, Truxillo.—1897, September, 10½ to 12 cents; November, 15 to 18 cents; February, 1898, 12 cents; September, 10 cents.

Oil, Aniseed.—Changes in price like a Chinese puzzle; 1897, October, $2.10; November, $1.85; December, $1.70; 1898, April, $1.60; May, $1.55; June, $1.75; September, $1.67.

Oil, Neroli Petali.—Perfumers must have found something new, as sales of this oil are growing less. Price has been $27 per pound, declining to $25 at this writing.

Oil, Cloves.—Advanced very much.

Oil, Cubeb.—Demand growing less; prices very low.

Opium.—Prices have advanced very much. We give the figures, average for each month: 1897, October, $2.60; November, $2.60 to $2.85; December, $2.60; 1898, January, $2.85; February, $2.90 to $3; March, $3 to $3.10; April, $3.10 to $3.25; May, $3.25 to $3.65; June, $3.45 to $3.65; July, $3.60 to $3.80; August, $3.65 to $3.75; September, $3.60 to $3.65. Imports for year, June 30, 1897,

to June 30, 1898, 123,845 pounds. The previous year the import was 1,072,914 pounds, a decrease in the past year of 949,069 pounds.

Paris, Green.—The sales of this are getting less every year.

Root, Calamus, Bleached.—It is said that the shrinkage of this root is very great, and prices are according to amount of moisture; selling now, 1898, September, from 28 to 35 cents.

Root, Ipecac.—This has reached the highest figure in the memory of many of us; selling in 1897, October, $1.65; November, $1.75; 1898, January, $2; March, $1.90; May, $2.20; June, $2.35; September, $2.45 to $2.60.

Root, Lady Slipper.—Another uncertainty as to price. Very little gathered this year.

Root, Mayapple.—Where this all is gathered is too much for your committee to say; believed by some to amount to nearly 2,000,000 pounds; prices have not been so high.

Root, Orris.—This has again declined. Florentine, from 12 cents in 1897, to 9½ and 10 cents in September, 1898, and Verona, from 9 cents in 1897, to 7 and 8 cents in September, 1898.

Root, Pink.—Only small decline; selling now, 17 to 20 cents, as to quality.

Root, Rhubarb.—This has been regular at the advance price of 1897; Canton, 30 to 40 cents, and Shensi, 50 to 65 cents.

Root, Sarsaparilla, Honduras.—Selling all the year, 28 to 34 cents.

Root, Sarsaparilla, Mexican.—Selling 5½ to 6½ cents.

Root, Senega.—Only the usual small changes.

Root, Squill.—Sales getting smaller; either new remedies for the babies or no babies for the squills. Price, 4 cents, all year.

Saffron, American.—Very low all the year; 12 cents all the year; now, September, 1898, selling at 11 cents.

Saffron, Valencia.—Selling 1897, September, $10.50; declining 1898, March, $9, and May, $10.50 to $11; September, $10 per pound.

Sulphur.—The war helped many of us to make very large profits on sulphur, being contraband of war, expected scarcity; many manufacturers bought heavy and at high figures, selling up to May 1, 1898, at 1½ to 1¾ cents, less 10 per cent. for quantity; when in one day it advanced to 6 and 7 cents net; May 7th dropped to 3½ and 4 cents; July, 3 and 3¼ cents; August, 2½ to 2¾ cents; September, 2 to 2⅜ cents, by discount of 5 to 10 per cent., as to quantity.

LITERATURE.

Pharmaceutical Catalogue. Frederick Stearns & Co., Detroit, Mich.

This catalogue contains a marginal index with copious notes of reference, and a large amount of general information pertaining to pharmacy that makes it of value as a ready reference book. It also contains doses and medical properties of nearly all the preparations listed in it. There is a very exhaustive index of botanical and common names, a number of tables of useful information, and a scheme for urinalysis. We understand that the books are now ready for general distribution, and that the publishers will send a copy to any established pharmacist on receipt of request.

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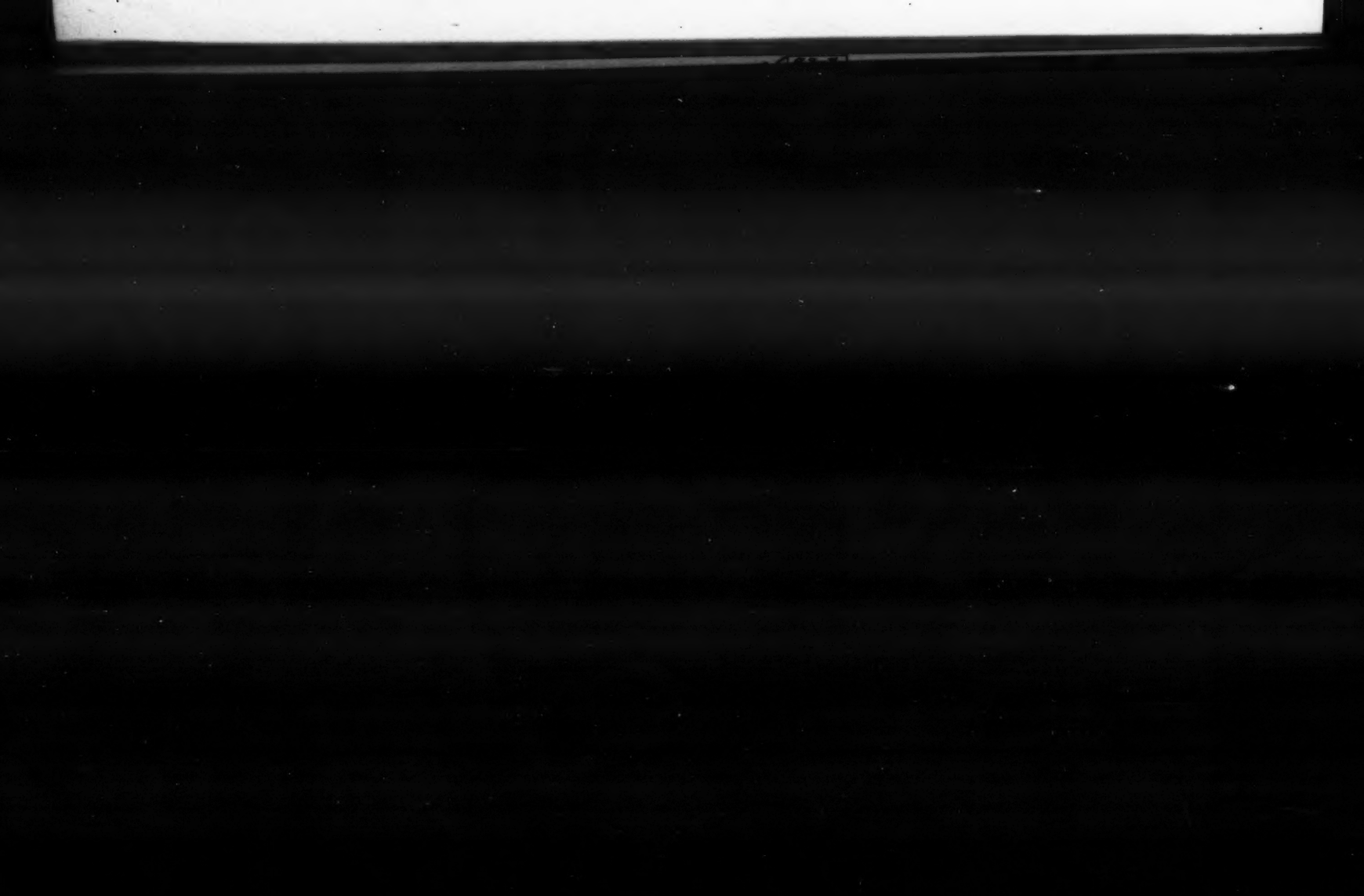

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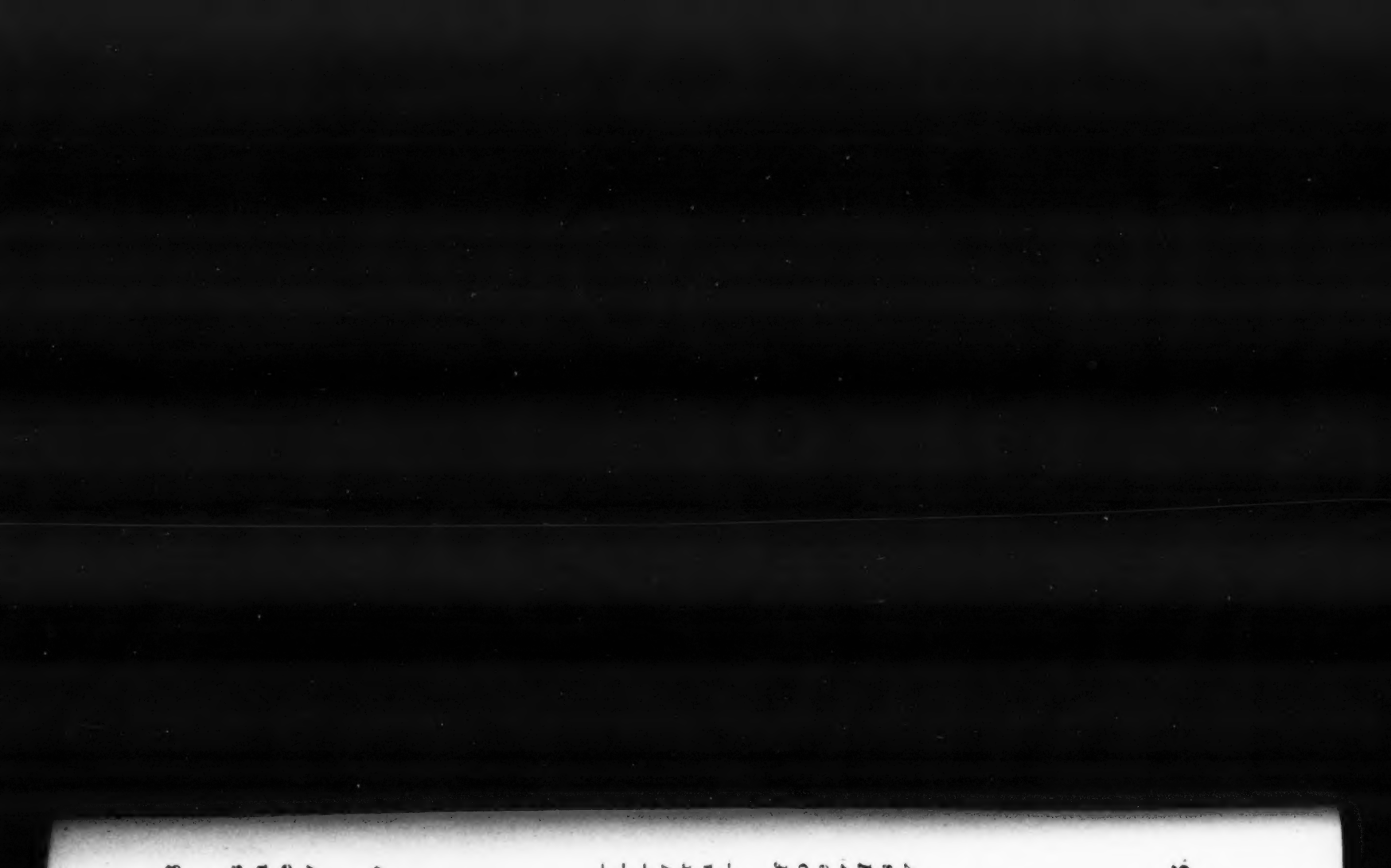

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